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BULLETIN

OF THE

ESSEX INSTITUTE,

VOLUME XXVIII.

1896.

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BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 28. SALEM: JANUARY,—JUNE, 1896. NOS. 1-6.

ANNUAL MEETING, MAY 18, 1896.

THE annual meeting was held in Plummer Hall, this evening, at 7.45 o'clock; Vice President A. C. Goodell, jr., in the chair. The record of the last annual meeting was read by the Secretary.

The reports of the Secretary, Treasurer, Auditor, and Librarian were read, accepted and ordered to be placed on file.

Vice President Edward S. Morse spoke in approval of portions of the Secretary's report, particularly of that part in reference to the method pursued in electing new members and also what was said about interesting young members to aid in arranging our collections.

The report of the committee on nominations was presented by the Chairman, Richard C. Manning, and it was

Voted, To proceed to the election of officers for the ensuing year. Messrs. William L. Welch, John H. Sears and Frank Cousins were appointed by the chair to distribute, collect, assort and count votes. This committee reported that the whole number of ballots cast was 92.

The ticket presented by the committee on nominations was as follows:

PRESIDENT:

ROBERT S. RANTOUL.

VICE-PRESIDENTS:

Abner C. Goodell, Jr.,
Daniel B. Hagar,
Edward S. Morse,
Alden P. White.

SECRETARY:

Henry M. Brooks.

TREASURER:

William O. Chapman.

AUDITOR:

Henry M. Batchelder.

LIBRARIAN:

Charles S. Osgood.

COUNCIL:

George H. Allen,
William H. Gove,
Thomas F. Hunt,
Francis H. Lee,
Richard C. Manning,
S. Endicott Peabody,
David Pingree,
Frederic W. Putnam,
Charles S. Rea,
George M. Whipple.

Of the ninety-two ballots cast for President

62 were for Robert S. Rantoul,
15 " " Alden P. White,
13 " " Abner C. Goodell, jr.,
2 " " DeWitt S. Clark.

Mr. Rantoul was therefore declared to be elected.

The others nominated were unanimously elected with the exception of a few scattering votes among one or two of the Vice-Presidents and one or two members of the Council.

REPORT OF THE SECRETARY, MAY 18, 1896.

In looking at the record of the past year we must all feel the great loss the Society sustained in the death of its honored President, the Rev. Edmund B. Willson. It will be remembered that at our last annual meeting Mr. Willson presided and, to all appearance, was in his usual health, having come from Petersham that very day, in order to be with us in the evening. He made, as you know, upon that occasion, a brief but excellent address in accepting the Presidency for another year. We little thought then that we were so soon to lose him. Within a fortnight from that time he was stricken down in his pulpit in the North Church, having just finished delivering his thirty-sixth anniversary discourse, and in the course of a few days passed away.

After the able and appreciative address of Vice-President Rantoul in Academy Hall, I do not feel that it is desirable for me to add another word; but perhaps I may be permitted to say that my personal relations with Mr. Willson extended over the whole time he lived among us, for I was a member of the North Society when he first came to Salem, and in fact proposed his name to the Committee of the Society, as the man for pastor, which circumstance led to his settlement over the North Church.

The name of another valued member of the Institute comes to my mind, Mr. George D. Phippen, who died on the 26th of last December. He was one of the original members of this Society and served in various offices from time to time. He was the faithful Treasurer for many years, and afterwards Auditor. He was always greatly interested in the success of the Society. He wrote many interesting historical articles in the early volumes of our Collections. He was not only a well-read historical and genealogical writer, but an accomplished botanist and well acquainted with various branches of Natural History. Many who listen to me will call to mind his fine garden in Bridge street, which for years afforded so much pleasure to his numerous friends. Whatever he undertook he did well. We all remember him as a quiet, unassuming and genial man. I feel that I knew him well, for I served two years with him in the Salem Bank, and in those two years, he taught me more than I had learned in all the years I had been at school, so that I have felt that I was under great obligations to him, and I am glad of the opportunity now offered, to pay my feeble tribute to his worth. It is a singular fact that these two good men, although differing somewhat theologically, had much in common, and often conferred with each other on religious matters and duties. This I know to be a fact, for Mr. Phippen himself so informed me, and it shows that truly religious people can differ in such matters, without being offensively partisan.

I trust I shall be pardoned for these few personal allusions, for I could not otherwise do even imperfect justice to those of whom I have been speaking.

Since the last meeting one hundred and thirty persons have become members of our Society, while eighteen have died, and fourteen have withdrawn, leaving the membership at the present time nine hundred and four. The additional members include, as life members, Mrs. John L. Gardner of Boston, Wm. D. Sohier of Boston, Amory A. Lawrence of Boston.

These are the members who have died during the year:

Henry Blaney, Theodore Brown, Hubbard Breed, Thos. J. Hutchinson, Wm. Mack, Amos H. Johnson, Edward H. Payson, Geo. D. Phippen, Wm. A. Bowditch, William G. Webb and Edmund B. Willson of Salem, Mrs. Eliza

D. Clement of Peabody, Mrs. Frederic Fry of Bridgeport, Conn., Octavius Howe of Beverly, Eustace C. Fitz, Alexander H. Rice, Henry W. Williams, Edward Wigglesworth of Boston (life member). One honorary member has died, William Wetmore Story of Rome, Italy.

It will be noticed that, in spite of losses, our membership has increased. There is no reason why we should not have a still larger increase, if some of our members would interest themselves to help us in this way. There are doubtless many men and women who would be glad to join us, if they understood they would be welcomed. As a general rule, people will not, of their own accord, come forward and ask to be admitted. That question was settled long ago, and our membership was declining before we adopted the new process of inviting people to become members, by electing them. If we had kept on in the old way, instead of having nine hundred members to-day we should have had but two hundred.

As I have often remarked, I think it is very important to enroll as many young people as possible, as members. Eleven of our members, who have died this last year, were upwards of seventy years of age.

There is another matter, in this connection, which I might as well speak of now. Have we not, among our members, some young men or women who would devote a little time occasionally, in assisting us in the arrangement of our Library and other departments of the Institute? We have, for instance, an immense collection of manuscripts of all kinds, and many of great value: letters, deeds and other legal documents, mercantile papers, genealogical minutes, etc., etc. Some have been inserted in books, but require to be indexed; many have not been arranged at all, and many have never been read, to ascertain their value. Now, with our present force and means, it would take perhaps twenty years to render these manuscripts available.

Perhaps this is asking too much in these bicycle days, and some may think, we are always begging for something, either donations or money or members. But let such consider the fact that, in the last report of the great British Museum of London, that institution was begging for more room. Indeed all similar institutions are always in want of more room or more money and, with the exception of the Essex Institute, seem to get it.

The free course of lectures in Plummer Hall the past winter has been as popular as ever. The lecturers have been, Gamaliel Bradford, Thomas H. Mullen, Samuel Cabot and Arlo Bates, of Boston, Prof. T. C. Mendenhall of Worcester, Edwin Reed of Cambridge, Edward Atkinson of Brookline, and Rev. D. S. Clark of Salem.

The Women's Local History Class have continued their meetings weekly since the summer vacation, and are as much interested in their work as ever. Those who desire further information about this class can receive it by application to the Secretary, Miss Helen D. Lander.

There have been twenty-five regular meetings of the Society, three meetings of Committees and two of Directors, one special meeting, December 28, to take action on the death of Mr. G. D. Phippen, and another, June 16, on account of the death of President Willson. A memorial meeting in honor of Mr. Willson was held November 7, in Academy Hall, when an interesting and eloquent address was given by Vice-President Rantoul upon the life and character of the President. Vice-President Morse presided at this meeting and made remarks appropriate to the occasion.

The evening meetings of members in the library room the past season have been well attended. Papers have been read by the following persons:

Miss Mary Ropes on "John Horn or Orne."

Miss Rosamond Symonds on "Salem Common," "Winter Island" and "The Neck."

Gardner M. Jones on "Public Libraries."

Miss Annie L. Warner on "Birds of Winter."

Gilbert L. Streeter, two papers on "Salem before the Revolution."

J. H. Choate, J. H. Sears, Harry R. Peach and John Robinson exhibited specimens under the microscope one evening, but owing to a severe storm, but few persons were present. The papers read were discussed by some of the members interested, and valuable facts brought out.

We have had a larger number of visitors during the past year than at any former period. The officers and assistants had about as much as they could do the last summer and fall to attend to callers: various large organizations, such as the Society of Christian Endeavor, the Universalist Christian Union, and the Masonic Society of Knights Templars,— each of these numbering thousands. Then there were the Auburndale Review Club, the Dorchester Woman's Club, the Randolph Literary Club, the New York Literary Club, besides several schools and classes. This will account for the great increase in the number of those who have visited the old first meeting house,— nearly 18,000, double the number who have ever visited it in the same time before. It is a curious fact that many people call for the key to this church, who have not time to examine our collections. They have to go to Marblehead or the Willows. Some of the schools and classes, before mentioned, have been addressed by Vice Presidents Morse or Rantoul, in Academy Hall, and other members of the Institute have conducted the strangers to places of historical interest about the city.

The inquiries of visitors to our rooms are sometimes quite amusing. This very season, at least two persons have asked to see the "Scarlet Letter," Hawthorne found in the Custom House. They had been told we had it. Once before, a lady said she had seen it some years ago in our rooms—she felt pretty sure about it, but it might have been at the Court House she saw it. Another person asked to see the instruments of torture which were used upon the witches. One lady asked if we could give information about an ancestor who came over with the early settlers; but did not know his name. She was anxious to be a Colonial Dame. Another wanted information to establish her right to be a "Daughter of the Revolution" or a "Daughter of the *American* Revolution," I have forgotten which. She knew she had a great grandfather in *some* Regiment, but could tell nothing farther.

The donations to the Cabinets the past year have been four hundred and twenty-nine from one hundred and seven donors. Among the more important donations was a fine copy in oil, from the original portrait of the Hon. Benjamin Goodhue, the first member of Congress from this District. This was the gift of his great granddaughter, our associate, Mrs. Sarah Goodhue King of New York City. Francis H. Lee, Esq., donated a rare old Dutch water-color view of Salem, at an early period. This picture was bought at a shop in Holland. From the estate of Esther C. and William Mack we received a miniature and a portrait of the Rev. John Clark, D.D., a former minister of the First Church in Boston, who was a native of Salem. We already had Dr. Clark's gold watch in our collection. From the same source we also received portraits of Judge Elisha Mack and wife, painted by Charles Osgood.

From John S. Williams, Esq., a large and valuable collection of manuscript papers, among them an original letter of Dr. Doddridge of England. There were also, in this lot, forty-eight old MSS. sermons, of the last century.

At the last annual meeting, Mr. Ross Turner referred to the condition of many of the old portraits in the Society's rooms, as requiring rebacking and restoring, to put them in a proper condition for preservation. The matter was referred to the Fine Arts Committee. This Committee has since had the work thoroughly done, and now all the portraits and other paintings belonging to the Society are in first class order.

The Publications of the Society have progressed favorably this year. The first part of Vol. 31 of the Historical Collections has been issued, and the second part, concluding the volume is now in press and nearly ready for issue. The first part of Vol. 27 of the Bulletin has been published, which includes the Annual Report for 1895. There does not appear to be much of a supply of good material fitted for publication in the Bulletin. The Visitor's Guide was issued under the imprint of the Essex Institute. The first of the special catalogues of the Institute Library was issued early in the year and was devoted to the Special Library on China. Among the leading articles in the Collections were:

A Historic Ball Room, by Robert S. Rantoul; List of Salem Vessels issued by Timo. Orne, John Nutting, Jr., and John Higginson, 1757, 1758, compiled by Geo. H. Allen; Lady Deborah Moody, by Mrs. Henry W. Edwards; Some Localities about Salem, by Henry M. Brooks; Memoir of Edmund B. Willson by Robert S. Rantoul.

Which is respectfully submitted,

HENRY M. BROOKS,

Secretary.

REPORT OF THE LIBRARIAN.

The additions to the library for the year (May 1895 to May 1896) have been as follows:

By Donation.

Folios,	38
Quartos,	204
Octavos,	1,412
Twelvemos,	308
Sixteenmos,	181
Twenty-fourmos,	101
Total of bound volumes,	2,244
Pamphlets and serials,	4,510
Total of donations	6,754

By Exchange.

Folios,	3
Quartos,	8
Octavos,	263
Twelvemos,	5
Sixteenmos,	5
Total of bound volumes,	284
Pamphlets and serials,	1,646
Total of exchanges,	1,930

By Purchase.

Folios,	3
Quartos,	5
Octavos,	16
Twelvemos,	1
Total of bound volumes,	25
Pamphlets and serials,	433
Total of purchases,	458
Total of donations,	6,754
Total of exchanges,	1,930
Total of additions,	9,142

Of the total number of pamphlets and serials 2,116 were pamphlets and 4,462 were serials.

The donations to the library for the year have been received from two hundred and four individuals and ninety-two societies and governmental departments. The exchanges, from fifteen individuals and two hundred and forty-nine societies and incorporated institutions, of which one hundred and twenty-four are foreign; also from editors and publishers. The largest single donation was from the estate of the late General Cogswell.

The library now contains about 70,000 bound volumes and something more than 200,000 pamphlets.

There is little for the librarian to say in his report this year except to reiterate and emphasize what he has said for the past five or six years. The library is greatly in need of funds to make it more available and useful to the public. It needs a fire-proof stack room for the storage of books' and it needs a catalogue. These needs appeal to the generously disposed as a most excellent method of benefiting the large number of persons who annually visit the rooms of the Institute, and the still greater number that would be attracted thither by increased accommodations and facilities. We are confident the aid will come in time, we hope in a comparatively short time, and when it comes the Institute will be able to be of greater service to the public in many ways. Until that time we must be content to go along as at present doing a little work each year and preparing the way for the future changes.

The interest in the library is fully maintained. It is frequently consulted and is of great use to students who are pursuing special lines of study and research. It does not aim to be a popular library, but pursues its work on different lines from the Public Library and Salem Athæneum, and by so doing avoids duplication, and relieves the libraries named from making any attempt to supply those books which are within the special line of work marked out by the Institute.

The quickened interest in the Institute is shown in its largely increased membership. Let us see to it that this interest is not allowed to flag, or grow cool, from any want of effort on our part.

Chas. S. Osgood,
Librarian.

Treasurer's Report.

RECEIPTS.

Balance from last report,		$804 75
Received from Invested Funds,	$3,246 26	
“ “ assessment of members,	2,382 00	
“ “ life membership fees,	150 00	
“ “ publications,	400 51	
“ “ Almy, Bigelow & Washburn, for reception fund,	25 00	
“ “ contributions for restoring pictures,	150 00	
“ “ other sources	241 64	6,595 41
		$7,400 16

EXPENDITURES.

Salaries of secretary, assistant librarian and janitor,	$2,598 15	
Fuel,	205 50	
Lighting and water,	129 12	
Shrubs and labor,	62 80	
Postage and express,	167 37	
Supplies,	103 81	
Storage,	37 80	
Furniture and fixtures,	65 09	
Repairs and new furnace,	288 60	
Restoring pictures and frames,	689 25	
Lecture expenses,	25 61	
Books,	449 42	
Publications and printing,	620 26	
Athenæum expenses,	168 36	
Miscellaneous,	35 21	
Annuities,	610 00	
Interest on loan,	218 66	
Atchison assessment,	80 00	$6,555 01
Paid on loan account,		500 00
Cash on hand,		345 15
		$7,400 16

Respectfully submitted,

W. O. Chapman, *Treasurer.*

AUDITOR'S REPORT.

[Indorsed on the above.]

SALEM, MAY 16, 1896.

Your auditor respectfully reports that he has examined this day the securities herein listed and finds them to agree with the treasurer's schedule.

The treasurer's books and accounts have been examined from the date of the last annual meeting. The receipts and expenditures appear to be properly entered and the books correctly kept.

H. M. BATCHELDER,
Auditor.

THE LOCAL HISTORY CLASS.

The Local History Class,—a spontaneous organization of ladies anxious to inform themselves more exactly on many of the interesting topics in the History of the County, is now well established and enters upon its fourth year. Its system is unique and might be adopted with advantage in other bodies. Subjects are assigned to individuals or to small committees, and a written report is made, which puts the whole class in possession of all the information gathered by the investigating party. This is at once a labor-saving and an inspiring system. The work of research, which calls for time and patience, may be done by a few for the benefit of the whole. The spirit of emulation prompts each investigator to do her best in unearthing something as worthy of attention as has yet been found. So the whole field of local history is gleaned afresh. And the results have already shown how much lies undiscovered, waiting to be disclosed to the descendants of some forgotten worthy, whose kin never until now had the leisure or inclination to look it up — and often of a quality and importance which compares well with what the livelier curiosity or superior opportunities of some other delver has long ago dug up.

The Local History Class numbers about sixty, and consists of ladies, although gentlemen are often honored with an invitation either to attend or to address its gatherings. Its organization is of the simplest. Once a year it elects a president and secretary. Its meetings occur weekly throughout the winter, and in summer include visits to different portions of the County and even exchange visits with kindred sisterhoods in other portions of the State. Twenty-five or more of these meetings have been held within the last year. Some of the papers read have shown a commendable amount of original thought and research, while others, which were mainly made up of matters already put on record, have presented familiar facts with so much novelty in method, and so contagious an enthusiasm as to give them the charm of things unknown.

The members of the Local History Class feel that they must, with the report of 1895 and '96, express their sense of the great loss sustained by them in the death of their founder and first leader, Mrs. M. M. Brooks, one of the most vitally interested members of the Essex Institute; the growth and welfare of which were very near her heart.

During her many weeks of illness she was constantly remembering her History Class, and the work they have accomplished this year is largely of her planning; as the class believed that, in fulfilling her plans, they could best show their regard for her.

Her good judgment was felt and known in many walks of life and her gracious presence was always a benediction to her friends, to whom her loss is irreparable.

TWO HUNDRED AND SEVENTY-FIFTH ANNIVERSARY OF THE LANDING AT PLYMOUTH.

Regular meeting, Monday, December 16, 1895. The Secretary called the attention of the members present to a notice received from the Plymouth Pilgrim Society, with an invitation to this Society to be present at its celebration, December 21, 1895.

It was voted that Hon. Robert S. Rantoul and Francis H. Lee, Esq., be requested to represent the Institute at the meeting of the Pilgrim Society, December 21, 1895, and those gentlemen attended.

The President of the Pilgrim Society, at the dinner, spoke as follows: The Essex Institute of Salem responds to our invitation, not by letter, but by its representatives in person. That Institute has done a great service in preserving the history and traditions of the Puritan founders of Salem; and I have the pleasure of introducing to you its representative, Hon. Robert S. Rantoul.

Mr. Rantoul's remarks were reported as follows:

Let me thank you, sir, that in the presence of this array of older bodies, you have not omitted to extend a hand to the Essex Institute. We are a young society, — painfully young, — much younger than you, not yet counting our first half century of life; — but we are vigorous and sprightly and active and growing. We are doing good work and, like all promising children, we like to be noticed.

One may well stand abashed, Mr. President, in the presence of such a scene as this. When I recall the mighty voices to which this spot has echoed — for what great orator has our continent produced who has not, first or last, planted his feet and lifted up his voice on Plymouth Rock, — who has not found here, first or last, the Mecca of his ambition, — the shrine of his patriotic and ancestral devotion? — when I listen, amidst the rolling of these waters, for one more trumpet tone from that matchless organ that is now silent but not forgotten in the wave-washed tomb at Marshfield, — when I recall the wonderful address made at the very outset of his career, standing on this very spot, invited by this very Society in the natal year of its existence, when, standing on the Rock of Plymouth, in 1820, two centuries complete, he uttered here that terrible denunciation of the barter in human flesh which goes ringing down the ages, now that personal weaknesses and party asperities have been long forgotten, — when I remember that unapproachable statement he made, of the interlocking, interacting relations and functions of the two sovereignties under which we Americans of to-day live and move and have our being, — a statement made in December, 1843, before the New England Society of the City of New York, and never to this hour improved upon — it is hard to believe it ever can be improved upon — I cannot but pause and hold my breath and utter a silent prayer for one more diapason-note from that most miraculous organ.

But, sir, you ask me for a word in behalf of the Essex Institute which sends me here charged with its greetings and good wishes. The relations of North and South Shore, — of Cape Cod and Cape Ann, have always been friendly and fraternal as they always should be, — never more so than in this present year of grace. We acknowledge with satisfaction, — we take pleasure to-day in reminding you of the debt, — the obligation incurred by the Massachusetts Bay Colony in the visit from your skilled and Godly practitioner, Deacon Fuller, when Governor Endecott, bitterly bereft in the loss of his courageous wife, found himself burdened with more than he could bear in the raging epidemic of ship-fever, which scourged us during the first desolate winter of our plantation. Says Nathaniel Morton, in his *Brief Relation or New England's Memorial:* "This year sundry ships came out of *England*, and arrived at *Neumskak*, (now called Salem), where Mr. *John Endecot* had chief command, and by infection that grew amongst the Passengers at Sea, it spread also among them on shore, of which many died, some of the *Scurvey*, and others of infectious *Feavers*. Mr. *Endecot*, understanding that there was one at *Plimouth* that had skill in such Diseases, sent thither for him; at whose request he was sent unto them. And afterwards, acquaintance and Christian Love and Correspondency came on betwixt the Governour, and the said Mr. *Endecot;* which was furthered by Congratulatory Letters that passed betwixt each other; one whereof, because it *shews* the beginning of their Christian Fellowship, I shall here insert."

Now it is not my purpose to tax your patience with long-drawn recitals. This is the Pilgrims' day and theirs is the honor and glory of it. They deserve it all. Nobody — certainly no Massachusetts Bay Puritan, — would withhold a tittle of the praise they are enjoying. But may it not be, in the exuberance of joy, that the merits of old Governor Endecott and his little band of rigid old Puritans may have been permitted, for the moment, to pass a little into the shade? Let us read this letter, if you will bear with me for a moment, slowly and lovingly together. It is not long. It is Governor Endecott's letter to Governor Bradford in recognition of the great kindness described by Morton in the passage I have read. It will do us good to hear it. It will be worth the time if it do no more than call to mind the lofty strain of courtesy, — the stately, official dignity which prevailed amongst these old-time magnates. But it will do more, unless language has lost its meaning, — unless words possess no longer a current value as the coinage of the heart. Let me read this letter of Governor Endecott's, and let us see if any better-conceived message of grateful acknowledgment, official or personal, has ever passed between these two communities before or since.

It may be true, far be it from me to deny — that our fine old Governor may have been a little hasty at times, with the emblem of popery in the King's colors, for instance; with the Anabaptists and Quakers and other schismatics and heretics; somewhat rough and rigorous at times, in correcting some little eccentricities in this neighborhood, in connection with certain May-pole proceedings, for instance; and your too practical free-trade views, in dealing in fire-arms and fire-water with that red-skinned fraternity, the Unimproved Order of Red Men. Allowing for all this I wish you would listen kindly to the old Puritan's letter, and see if you have any doubt, when you have heard it, about its being written by a gentleman. Here it is:

"To the worshipful and my right worthy friend, William Bradford, Esqr., Governor of New Plymouth, these,—

Right Worthy Sir:

It is a thing not usual, that servants to one master and of the same household should be strangers; I assure you I desire it not; nay to speak more plainly, I cannot be so to you: God's people are all marked with one and the same mark, and sealed with one and the same seal, and have for the main, one and the same heart, guided by one and the same spirit of truth; and where this is there can be no discord, nay, here must needs be sweet harmony; and the same request (with you) I make unto the Lord that we may, as Christian brethren, be united by an heavenly and unfeigned love, bending all our hearts and forces in furthering a work beyond our strength, with reverence and fear, fastening our eyes always on Him that only is able to direct and prosper all our ways. I acknowledge myself much bound to you, for your kind love and care, in sending Mr. Fuller amongst us, and rejoice much that I am by him satisfied, touching your judgment of the outward form of God's worship; it is (as far as I can yet gather) no other than is warranted by the evidence of truth, and the same which I have professed and maintained, ever since the Lord in mercy revealed himself unto me, being far different from the common report that hath been spread of you touching that particular; but God's children must not look for less here below, and it is the great mercy of God that he strengthens them to go through with it. I shall not need at this time to be tedious unto you, for, God willing, I purpose to see your face shortly: In the meantime I humbly take my leave of you, committing you to the Lord's blessed protection, and rest.

Your assured loving friend and servant,

JOHN ENDECOT.

Naumkeak, May 11, Anno 1629."

So you see, gentlemen, that Dr. Fuller's mission bore double fruit; he relieved the North Shore colonists of a plethora of the vital fluid, but he also relieved the mind of Governor Endecott of some qualms about the heterodoxy of his Plymouth neighbors. Perhaps this last was as great a service as the other. Perhaps the deacon was no less welcome than the doctor, for our excellent Governor was no bungler in the art of physic. He could administer law, medicine or theology upon occasion. He had brought with him, as every navigator does on a voyage, a well-filled medicine chest, with its recipes and ban-

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dages, and cataplasms, and with hand-books—books, says the inventory of the estate, "both of physic and chyrurgery, with one saw and six other instruments for a chyrurgeon." But when he found his outfit of science and *materia medica* unequal to the exigency, he did what any sensible professional man would have done—called in a consulting physician. If there were time, I should like to read to you from the report of the case made to Governor Bradford by that estimable "chyrurgeon and physitian," Deacon Samuel Fuller, because it shows how blood-letting and catechising travelled hand in hand, and it also shows a wholesome belief in a personal devil prevailing in this section. If you have, by any means, been led to regard the "ould deluder, Satan," as a perquisite of the Bay Colony, as a product or appanage exclusively of the North Shore, I beg you to observe that your own saintly Dr. Fuller, in his letter, from which I shall read a line, not only recognizes our old friend, the father of mischief, at sight, but even regards the North Shore potentate as a pretty fair match for the beneficent powers of the universe. Here is one of Dr. Fuller's despatches to his home government, if you will allow me to read from it, showing that theological contention at that time came as easy as blood-letting. He writes: . . . "I have been at Matapan, at the request of Mr. Warham, and let some twenty of these people blood; I had conference with them 'til I was weary. Mr. Warham holds that the visible church may consist of a mixed people, godly, and openly ungodly; upon which point we had all our conference, to which, I trust, the Lord will give a blessing. . . . We have some privy enemies in the bay, but (blessed be God) more friends; . . . oppressors there is not wanting, and Satan is busy; but, if the Lord be on our side, who can be against us? . . . Captain Endecott (my dear friend, and a friend to us all), is a second Burrow. The Lord established him, and us all, in every good way of truth! . . .

Yours in the Lord Christ,

SAMUEL FULLER.

Massachusetts, June 28, Anno 1630."

I fear Governor Endecott was not able during his lifetime to make to Plymouth any return of a favor of this magnitude, but he was only ten years in his grave when King Philip's war broke out; when that dusky strategist and statesman,—the first expounder, as I take it, of the Monroe Doctrine on this continent, began swinging the tomahawk, without discrimination, over fighters and skulkers, babes and mothers, patriarchs and preachers; letting his bludgeon fall, like the rains of heaven, alike on the just and on the unjust in this Plymouth Colony. Blazing Medfield was rolled up like a scroll, and pillage and massacre seemed to wait on what was spared by fire. If ever a struggling colony wanted help, Plymouth wanted help at that hour. Providence had favored us at that hour with a doughty champion in the person of Captain Joseph Gardner—the "Fighting Joe" of the period—who buckled on his harness, and mustered his musketeers, and marched out at the head of a gallant train-band from his home in Salem,—that home not three doors off from the present quarters of the Essex Institute,—to do and to die in effective battle for the safety of the Plymouth Colony, and there, in Narragansett Swamp, to render up a dearly valued life inside the palisado breastworks of the savage chieftain. I thank you, sir, for the opportunity of a word; and you, gentlemen, my listeners, for your courtesy and patience in permitting me to refresh your recollections on two events which should forever bind together the destinies of Eastern Massachusetts.

LECTURES.

Monday Evening, January 6, 1896.—Regular Meeting in the Library room.— Three interesting papers were read by members of the Local History Class,—one by Miss Mary Ropes, on "John Horn or Orne," which called out a discussion on the Orne Family, and the other two by Miss Rosamond Symonds, on "Salem Neck and Winter Island," and on "Salem Common." It was further

Ordered, that this memorial of the last survivor of the original board of government of the Essex Institute be spread at large upon our records, and that a copy thereof be transmitted to the family of the deceased.

George Dean Phippen was born at Salem, April 13, 1815, in a homestead now numbered 20 on Hardy street. The Phippens were domiciled in Salem before Charles I made way for Cromwell to govern England and her dependencies. For the more than fourscore years of his life, Mr. Phippen has had no other residence than Salem. He died at his home on Bridge street, December 26, 1895. He was the son of Captain Hardy Phippen and of Ursula Symonds Phippen, his wife.

Captain Hardy Phippen was a clerk under our first Collector Hiller at the close of the last century, and later an Inspector of Customs in the Salem Custom House. He navigated the craft used by Dr. Bowditch in sounding and surveying Salem harbor for his famous charts, and was with the great astronomer on his early voyages while his monumental life-work, Bowditch's Navigator, was shaping itself in his mind. Captain Phippen's first voyage was sailed, 1795, in Elias Hasket Derby's famous ship "Astrea." He followed the sea for upwards of twenty years, sailing far and near for the Pickmans, Crowninshields, Derbys and Pickering Dodge. In 1808, he was mate of the brig "Nabby," when Captain Nathaniel

Hathorne, the romancer's father, in command of her on a voyage to Surinam, died in that port. Captain Phippen came home in command, and brought from Frenchman's Bay, on her next voyage, the exceptional cargo of selected lumber used in building and finishing the Woodbridge mansion at the corner of March and Bridge streets. In our second war with England Captain Phippen did service in the building of Fort Lee, and at its close, in 1815, took the news of peace to Calcutta in the Salem ship "Favorite." A sketch of him from the pen of Hon. Charles W. Upham appeared on the occasion of his death at the age of ninety in 1868. From such a father George Dean Phippen derived many of his most endearing qualities.

Mr. Phippen, after enjoying the excellent opportunities afforded by the Salem teaching of that day, took his place, on leaving school, first in the counting room of John Fiske Allen, and then, in 1838, at the age of twenty-three, connected himself as bookkeeper with the Salem Bank, then occupying rooms in Pickman Place. Twenty years later he became its cashier and remained in that position until his death, thus completing a service in a single monetary institution of fifty-seven years. Four years before entering on his life-work at the Bank, and while yet in his teens, he had taken part in an incipient movement to establish a society for the study of natural history in this county. The effort bore fruit in such an organization, formed at Topsfield in April, 1834, and Mr. Phippen was an original member of it. In 1843 he became a member of the Essex Historical Society, so that when these bodies were united in 1848 to form the present county organization, Mr. Phippen, belonging to both, was doubly a charter member of the Essex Institute. He was chosen and served for years as its first librarian; later, he was for twelve years its treasurer, and for more than twice that period its financial guide, and lived to be the last survivor of its first board of government as well as of the original membership of the Essex County Natural History Society.

During Mr. Phippen's early years at the Salem Bank in Pickman Place, the second floor of the old banking house was variously occupied by societies in which he took an active part: the Essex Historical Society, the Salem Athenæum, the Natural History Society, the Essex Institute, in turn had chambers overhead. And besides his contributions of service to these last he acted as superintendent of the East India Marine Museum, not a stone's throw away, for the seven years succeeding 1848, at which date the activity of Dr. Wheatland, in that sphere, seems to have been transferred from the Museum to the Essex Institute just formed.

He succeeded Dr. Wheatland as superintendent of the Museum in November, 1848, and received a vote of thanks from the Marine Society on retiring in November, 1855.

Mr. Phippen was through life an ardent lover of flowers, and this passion manifested itself in many ways. Broad in his denominational views, his interest in the Tabernacle Church led him to furnish the most fitting floral decorations for his place of worship. His beautiful garden, looking out on Collins Cove, made famous through the water-colors of our artist-townsman, Turner, absorbed for years a generous portion of his time and thought. He soon came to be recognized as an authority on floriculture as he had long been on local history. The fruit and flower shows of the Institute, which were sustained with great acceptance in various halls of the city, but especially in that of the Chase Block, now superseded by the Holyoke Building, were greatly helped by Mr. Phippen's zeal, liberality and good taste.

Rarely, during the flourishing period of our field-meetings, was Mr. Phippen absent from one of these gatherings and, when present, rarely silent—being almost uniformly called on to discourse on the typical botany of the region visited. At a great field-meeting in Manchester, held August 2, 1866, at which Chief Justice Chase was present and took part, Deacon Fowler of Danvers was called on to describe the trees and Mr. Phippen the flowers of that seaside region. So admirably did they discharge this task that the Chief Justice,—himself a varied scholar of no mean attainments,—more than once expressed his wonder and delight that gentlemen so preoccupied with responsible business affairs should have reached such a mastery of these beautiful sciences as well. In this department Mr. Phippen very liberally enriched our publications with the products of his pen, contributing to the second volume of the Bulletin articles entitled, "The Plants of Scripture,"—" Dark Lane and the Wild Flowers of Salem,"—and " The Flora of Bradford."

But his interest in the Institute was not limited to the scientific side. In volumes I and IV of our Historical Collections are found papers of his, of the highest authority and value, on the original settlers of Massachusetts Bay,—the Old Planters of Cape Ann. So strongly ingrained in his nature was this fondness for the archaic that, when he had need to name a street just opened near his famous garden, and in the line of a possible development of Collins Cove as a tidal basin or water-park,—a scheme which has more than once had the endorsement of past Mayors of Salem, who have sought to remove the Almshouse with its repulsive adjuncts to another section and to throw open the Neck lands to improvement for residential uses,—Mr. Phippen selected " Planters' Street " as a name well fitted to keep alive the memory of the pioneers and to mark the locality of Planters' Marsh where, in the day of small things, the early denizens of this historic region cut their thatch and flagging. The touching tribute paid by Mr. Phippen to his early associate and life-long coadjutor, Doctor Wheatland, at the memorial exercises reported in volume XXX of the Historical Collections, was marked by a delicacy of tone, a discrimination and insight, a fineness of phrase and a genuineness of sentiment which give it rank as a model characterization.

On the twenty-fifth anniversary of his birth, Mr. Phippen was united in marriage with Margaret, a daughter of Captain John Barton, of Salem, and she, with three sons, survives him. His seventy-fifth birthday brought with it the golden anniversary, closing a half-century of cherished companionship, and this was very generally remembered by his friends and neighbors. At the joint parade of the Second Corps of Cadets and the Salem Light Infantry, a few years since,—that auspicious hour in which the jealousies and rivalries of a century were buried out of sight, Mr. Phippen marched with three sons, shoulder to shoulder, in the Veteran Light Infantry. He joined the active corps in 1832. With no lack of manly quality, there was a fineness of fibre in Mr. Phippen's nature which no one who was brought into close relations with him could fail to recognize. His was one of those rare spirits that rise so far above the grossness of the world that to praise them seems almost an impertinence. He seemed to keep to the last all the native freshness of his early days and to refine away, as time went on, whatever dross alloys this mortal part.

In his death one more link is parted, and that a bright one, which bound together the present and the past.

Monday, Jan. 13, 1896.—The first lecture in the "free course" was delivered this evening, in Plummer Hall, by Gamaliel Bradford, Esq., of Boston, on the "Monroe Doctrine."

Mr. Bradford's views seemed to be somewhat in opposition to those of the President and a majority of the members of Congress. He was opposed to war with England under any circumstances and especially in the condition in which the country now is, although he said he was a thorough American in his feelings. But he did not believe there was anything to be gained by a war even if the "Monroe Doctrine" should be affected by British movements in Venezuela.

Monday, Jan. 20, 1896.— Regular meeting in the Library room. Mr. Gardner M. Jones, Librarian of the Salem Public Library, read a very interesting and instructive paper on "Public Libraries," describing in detail their management, their great value and their remarkable increase in number within a comparatively short period. He gave a description of the Boston Public Library, with some criticisms on its general character.

Monday, Jan. 27, 1896.—Thomas A. Mullen, Esq., of Boston, lectured this evening in Plummer Hall, on "Impressions of Europe." He gave a very interesting account of a rambling visit to various European countries, during the last summer, with many humorous observations on men and things abroad.

Monday, Feb. 3, 1896.—Regular meeting in the Library room. Miss Annie L. Warner, of Salem, gave an interesting lecture on the "Birds of Winter." She spoke of the birds noticed as coming every winter, and those that come occasionally, and of those that are with us every month of the year. She illustrated her subject by specimens from the Peabody Academy of Science.

Monday, Feb. 10, 1896.—Prof. T. C. Mendenhall, of Worcester, lectured in Plummer Hall this evening. The subject was "Chance and the Long Run," illustrated with the blackboard and with lantern views. He spoke of what is commonly known as chance and showed how little chance there really is in it. By diagrams and figures he showed how little the accidents on railroads vary from year to year. He explained clearly how even the common events of life may seem like chance but they simply follow out a natural order of things.

Monday, Feb. 17, 1896.—Regular meeting in the Library room.

Monday, Feb. 24, 1896.—Messrs. Samuel Cabot of Boston, and Edwin Reed of Cambridge, lectured in Plummer Hall this evening. Mr. Cabot explained the cypher which it is claimed Bacon used to show that he wrote the Shakespeare plays. Mr. Reed demonstrated that the education and early training of Shakespeare and his associations and surroundings at Stratford were all against the possibility of his authorship of the works attributed to him. He believed they were written by Francis Bacon who, for political reasons, did not wish, in his time, to be known as the author.

Monday, March 2, 1896.—Regular meeting in the Library room.

Monday, March 9, 1896.—Prof. Arlo Bates, of the Institute of Technology, Boston, lectured this evening in Plummer Hall, on "Dr. Johnson and his Dictionary."

The lecturer gave a brief history of the several attempts at dictionary making before Dr. Johnson's day and then gave an account of the arrangements made by some London booksellers for the publication of Dr. Johnson's dictionary, which was begun in 1747 and finished in 1755. The work cost the Doctor £100 more than he received from the publishers so he only made a reputation by the work. Professor Bates gave a number of the amusing definitions from the first edition of the dictionary and spoke of the peculiar characteristics of Dr. Johnson in connection with this work.

Monday, March 16, 1896.—Regular meeting this evening in the Library room. On motion of Mr. Richard C. Manning, the following resolves were passed:

Resolved, that no more fitting or more lasting memorial of the virtues of the fathers can be desired than the publishing and distribution of the Records of the Continental Congress by the Government of the United States.

Resolved, that the Essex Institute earnestly desires and recommends the execution of this proposed work and respectfully urges upon our representatives in Congress the support of all proper measures looking to that end.

Mr. Gilbert L. Streeter read a portion of his paper on "Salem before the Revolution," which will appear in the Historical Collections.

Monday, March 23, 1896.—Edward Atkinson, Esq., of Boston, lectured this evening in Plummer Hall, on "The Altruistic Motive of Self Interest." The lecturer said he knew of no other word than altruism which so completely embodies the idea of that mutual service, which is the law of progress by which men are governed whether they will or no. Resistance to the natural law of altruism is the chief cause of war and want.

Monday, March 30, 1896.—The last lecture in the course was given this evening in Plummer Hall by Rev. D. S. Clark. He gave an interesting account of his travels in Constantinople and on the Bosphorus. Illustrated with lantern views shown by Rev. J. F. Brodie.

Monday, April 6, 1896.—Regular meeting in the Library room. Mr. Gilbert L. Streeter read the second part of his paper on "Salem before the Revolution."

On Wednesday afternoon, May 6, 1896, an address was delivered by Miss Kingsley, at Academy Hall, under the auspices of the Institute, upon Warwickshire, and the Personality and Surroundings of Shakespeare. Vice-President Rantoul filled the chair and, in presenting the distinguished lecturer, spoke substantially as follows:

On the 16th of February, 1874, the Reverend Charles Kingsley, accompanied by Miss Kingsley, his daughter, paid us the honor of a visit and began here his lecture-tour of the United States. I shall attempt no characterization of Mr. Kingsley. There is no need of that. The American Cyclopedias of Biography and the Encyclopedia Britannica unite in assigning him to the front rank in the literature of our common tongue. He was a Devonshire man, born in that beautiful southern county of England from which this Colony drew so many of its sturdy pioneers. And his ancestors bore their honorable part with the Ironsides of the south of England amongst the Puritan patriots of Cromwell's day. His mother was half American, a native of Barbadoes.

If I presume to postpone for a moment the pleasure you are anticipating, it is to say that Mr. Kingsley was one of those visitors who come here in a friendly mood, and whose broad culture opened his mind to favorable impressions of the best this country had to offer him. Naturally we feel kindly towards those who accept us at something near our estimate of ourselves. Mr. Kingsley had for years perceived, what some of his compatriots had been unable to perceive,— that there was in America a social condition which would well reward the study of Englishmen of understanding; that this nation was not engaged in trying to make of itself a cheap and feeble copy of Great Britain, but had a conscious destiny of its own, fresh and high and admirable and noble, which for better or for worse we have been placed here, in the best part of this western continent, to work out. During the period of our Civil War and of the Reconstruction Era, Mr. Kingsley filled the important Chair of Professor of Modern History at Cambridge University, of which he had been an alumnus. He made American History the topic of his lecture course for 1862, and in announcing his purpose to do this to a friend in December, 1861, he used these words:

"As for the American question . . . I have thought of nothing else for some time. For I cannot see how I can be a Professor of past modern history without the most careful study of the history which is enacting itself around me . . . So strongly do I feel the importance of this crisis, that I mean to give, as my public lectures next October term, the History of the American States." In 1866 he was seconding the movement of a Liverpool gentleman of large views and means for the endowment at Cambridge of a Professorship of American History — a distinctly American Lectureship which was to be filled by an American selected and endorsed by the authorities of Harvard.

This extremely radical proposal, addressed to the conservatism of the mother country, naturally came to nought. But the language used by Mr. Kingsley, — still filling with distinction the Chair of Modern History at Cambridge — shows the feeling which he, in common with too few other leaders of English thought, entertained towards us at the close of our war, and I ask your indulgence in quoting from a letter of Mr. Kingsley to his friend, Sir Charles Lyell, who also knew something of us here in Salem from personal contact and observation. These are among Mr. Kingsley's words: — "When I did myself the honor of lecturing in this University on the History of the United States, I became painfully aware how little was known and how little there could be known on the subject. This great want has been since supplied by a large addition to the University Library of American literature. I think it most important that it should be still further removed by the residence among us of an American gentleman."

"Harvard University is a body so distinguished that an offer of this kind is to be looked on as a very graceful compliment."

"Of the general importance of the scheme, — of the great necessity that our young men should know as much as possible of a country destined to be the greatest in the world, I shall say little. I shall only ask, If, in the second century before the Christian era, the Romans had offered to send a lecturer to Athens that he might tell Greek gentlemen of what manner of men this new Italian power was composed, — what were their laws and customs, their intentions, their notion of their own duty and destiny, — would Athens have been wise or foolish in accepting the offer?"

These and other arguments in favor of an American

Professorship — of establishing a sort of Ambassador Extraordinary of Letters at the Court of St. James — were embodied by Mr. Kingsley in an extended address issued at Cambridge, which it was hoped might influence the authorities of the University to accept the proposal. But the movement bore no fruit.

To-day we have the great pleasure to welcome again the daughter who visited Salem with Mr. Kingsley and made the notes, since published, of his American journey. She has recorded in those notes the fact that the Old World, South of England names of places and persons which he found surviving here about Salem were to him a never failing source of interest and pleasure. She will address us to-day on Warkwickshire with something of the personality and social surroundings of Shakespeare, a timely topic, since our Baconian friends have done what they could of late, to persuade us that Shakespeare had little or no personality and no social surroundings worthy of mention. Miss Kingsley has lived in that delightful midland county — the heart of England — to which many of us are no strangers, and where the name "Shakespeare" may still be read in the simple annals on church-yard gravestones and in one instance, at least, on the door-plate of a dressmaker pursuing her art to-day.

I have the honor and very great pleasure to present Miss Kingsley.

[Miss Kingsley's address was listened to with much interest by a large and critical audience.]

An adjourned meeting of the Institute was held June 18, Vice President Rantoul in the chair. The death of our late President, the Rev. Edmund B. Willson, was referred to.

[The funeral was at the North Church on Saturday, June 16th. George H. Allen, Ezra D. Hines, Ross Turner, George M. Whipple and Alden P. White, were requested by the Executive Committee of the Institute to attend and represent the Society.]

On motion of Mr. Thomas F. Hunt it was

Voted: That a Committee of three be appointed by the Chair, of which the Chairman shall be one, — with full powers, — to take some action in regard to the death of the late President, the Rev. Edmund B. Willson.

Voted: That the thanks of the Essex Institute are due and are hereby tendered to Mrs. Sarah Goodhue King of New York City, the great granddaughter and last lineal descendant of Benjamin Goodhue of Salem, for an admirable portrait in oil, just received, of her distinguished ancestor. A native and life-long citizen of Salem, born September 20, 1748, at the Goodhue homestead, now standing near Goodhue street and numbered 70 on Boston street, Benjamin Goodhue took his degree at Harvard at the early age of eighteen and also received an honorary degree from Yale in 1804. He embarked in commerce, and at the outbreak of the Revolution became engaged in public affairs. He represented Essex County in the Senate of Massachusetts for 1784-9, when, under the new Federal constitution, he filled for three terms the seat of Congressman for this district, and with the aid of a single colleague, framed the system of revenue laws, which has proved a monument to his skill, assiduity and foresight. He became a United States senator for Massachusetts in 1796, upon the resignation of George Cabot, and acted as chairman of the Senate committee on commerce, but retired to private life four years later, and died July 28, 1814, at the mansion on Essex street now numbered 403, which he erected and occupied most of his years. The portrait, so kindly presented to the Essex Institute, is "an excellent copy" made in New York City by William Southworth in 1895, from a likeness painted from life by J. Wright in 1790, and regarded by Mr. Goodhue and his family at that time, as a good likeness. Such a gift is an invaluable accession to the historical storehouse of Essex County, and finds its natural resting-place on the walls of the Institute.

Voted: That the above be spread at large on the records and a copy forwarded to the generous donor of the painting.

Tuesday, June 25, 1895.—A meeting of the committee to report what action should be taken on the death of the President, Rev. Edmund B. Willson, was held this day. On motion of Mr. Charles S. Osgood, it was voted that a series of resolutions be reported to the Institute at its next meeting. On motion of Mr. T. F. Hunt, it was voted that Mr. Rantoul be requested to prepare a memoir of Mr. Willson to be presented to the Institute in October next.

Regular Meeting, Monday, July 1, 1895.—The Committee chosen at a meeting of the Essex Institute held June 18, 1895, to consider and report what action it would be proper to take on the recent lamented death of President Willson, beg leave to report:—That with the exception of the case of Dr. Wheatland, which was unique, the action of the Institute upon the death of its Presidents has been substantially uniform.

Judge White died in office, April 1, 1861, after a long term of service. Resolves were passed, and Rev. Dr. G. W. Briggs was requested to prepare a memoir which was read before the Institute, January 4, 1864.

Colonel Peabody died in office after a brief service, October 31, 1867. Resolves were passed, and Hon. Charles W. Upham was requested to prepare a memoir which was read, July 18, 1868.

Ex-Mayor Huntington, an ex-President who had served four years, died September 5, 1870. Resolves were passed, and Judge Lord was invited to prepare a memoir, which he read before a meeting of the Institute, September 5, 1871.

Your committee believe that the Institute can not do better than to continue the precedent so wisely established, and they recommend that the testimonial of regret herewith submitted, be spread upon the records and transmitted to the family of the late President Willson, and that a memorial be prepared, to be presented to the Essex Institute at a meeting to be held in October next.

By the committee,

ROBERT S. RANTOUL.
THOMAS F. HUNT.
CHARLES S. OSGOOD.

RESOLVES.

Edmund B. Willson, the fifth President of the Essex Institute, died after a brief illness at his home in Salem, June 13, 1895. He was born at Petersham, August 15, 1820. He was the son of a clergyman and teacher of youth. He was a student at Yale College and at the Harvard Divinity School and received from Harvard, in 1853, the honorary degree of Master of Arts. He began his ministry at Grafton, January 3, 1844, and, after preaching there with acceptance, was called to West Roxbury as the successor of Theodore Parker, July 18, 1852. He became pastor of the North Church in Salem, June 5, 1859, and was stricken down in that pulpit at the close of his thirty-sixth anniversary service, on Sunday, June 2, 1895.

In addition to the pastoral duties to which his life was given, Mr. Willson assumed others imposed upon him by his ardent sympathy with all worthy endeavor. Twice he yielded to the promptings of patriotism. He served as Chaplain of the 24th Regiment of Massachusetts Volunteers in its Florida and Virginia campaigns from October 1863 to July 1864. He sat in the General Court as a Representative from Salem in 1883 and 1884 and there became the champion of the broadest educational policies known to the Commonwealth,— objects as these had been of his life-long devotion,—serving the State as chairman, in his branch, of the Committee on Education. From the days of Horace Mann he has labored on the school boards of Grafton and of West Roxbury and for eight years on that of Salem, and no man knew and loved the schools of Massachusetts more thoroughly than he. Few of the charitable and correctional establishments of Salem have failed of encouragement in some form from him. A number — too many to enumerate — have recognized his aptitude and their indebtedness, by choosing him to office. Everywhere he was the welcome coadjutor in all good works. Creeds had no terrors, sectarian and party lines no restrictive potency for him. The friend of all men, he could coöperate with all. Fearless and without guile, he was a man to whom all hearts were drawn, for his words even in the most sacred experiences of life were wise and fit — a spirit fine enough for any sphere — a man whose simple presence was a benediction, whose voice and look bespoke the soul within. To the great company of pastors, revered and honored, who have illustrated our annals, from the Higginsons and Williams and Peters and Prince and Barnard and Bentley to the later times, it is permitted us to add another name as lastingly enshrined in the affections of his townsmen as those who went before.

Mr. Willson's active connection with the Essex Institute began with his ministry in Salem. We find him at an early day attending field-meetings, — occasions which especially interested him for their novelty, — and now and again accepting the chair. From the first he has rendered enthusiastic service on important committees. He was chosen President at a special meeting in June, 1893, and then at the annual meeting in May, 1894, with the stipulation that the Institute must content itself with such attention to the office, as his many preoccupations would permit, and at the annual meeting in May, 1895, he was again elected and accepted the office in warm and well-chosen words still lingering in our ears. During these years he was the President of the Salem Athenæum and a Vice-President of the New England Historic Genealogical Society as well. What advantage was to accrue from the official influence of so rare a personality, holding so preëminent a place in public feeling and thought, was hardly to be demonstrated in the months which have intervened. The members of the Essex Institute record their loss with profound regret, and hold it to be a matter of pride that they are able, even for so short a term, to enroll amongst the incumbents of their highest office, the name of Edmund B. Willson.

Voted: That this report be spread in full upon the records and that a copy of it be transmitted with the deepest sympathy of the Essex Institute to the family of the late President.

Voted: That Vice President Rantoul be requested to prepare a memorial of Mr. Willson to be presented in October next.

NECROLOGY OF MEMBERS.

HENRY BLANEY, son of Benjamin and Abigail (Bowman) Blaney, was born in Boston, Jan. 3, 1822; elected a member of the Essex Institute, Nov. 16, 1891, and died in Salem, Feb. 2, 1896.

William A. Bowditch, son of Ebenezer and Mary (Appleton) Bowditch, was born in Salem, in 1809; elected a member of the Essex Institute, March 11, 1857, and died in Salem, May 15, 1896.

Hubbard Breed, son of Lucius H. and Rebecca (Story) Breed, was born in Salem, Jan. 27, 1844; elected a member of the Essex Institute, Jan. 15, 1894, and died in Salem, May 9, 1896.

Theodore Brown, son of Jonathan and Sarah C. (Hill) Brown, was born in Salem, in 1818; elected a member of the Essex Institute, Nov. 25, 1867, and died in Salem, June 8, 1895.

Mrs. Eliza D. Clement, daughter of Hazen and Serena (Dustin) Ayer, was born in Salem, in 1834; elected a member of the Essex Institute, April 15, 1895, and died in Peabody, Feb. 26, 1896.

Eustace C. Fitz, son of Jeremiah and Hannah (Eaton) Fitz, was born in Haverhill, in 1833; elected a member of the Essex Institute, Nov. 19, 1894, and died in Boston, May 27, 1895.

Mrs. Matilda B. Frye, daughter of Benjamin Brooks and widow of Major Fred Frye, was born in Bridgeport, Conn., in 1829; elected a member of the Essex Institute, June 3, 1895, and died in Bridgeport, Conn., Nov. 27, 1895.

Octavius Howe, son of Abner and Sarah (Thorndike) Howe, was born in Beverly, Jan. 22, 1815; elected a member of the Essex Institute, Aug. 19, 1863, and died in Beverly, Oct. 30, 1895.

Thomas J. Hutchinson, son of Thomas and Nancy (Bowden) Hutchinson, was born in Salem, in 1822; elected a member of the Essex Institute, March 20, 1876, and died in Salem, July 15, 1895.

Amos H. Johnson, son of Samuel and Charlotte (Howe) Johnson, was born in Boston, in 1831; elected a member of the Essex Institute, Jan. 7, 1867; Secretary for 1868, 1871, 1872; and died in Salem, May 12, 1896.

William Mack, son of Elisha and Catherine S. P. (Orne) Mack, was born in Salem, in 1814; elected a member of the Essex Hist. Society, June 30, 1841; an original member of the Institute, and died in Salem, June 9, 1895.

Edward H. Payson, son of Lemuel and Joanna (Newhall) Payson, was born in Salem, in 1804; elected a member of the Essex Institute, June 9, 1864, and died in Salem, Oct. 26, 1895.

George D. Phippen, son of Hardy and Ursula (Symonds) Phippen, was born in Salem, April 13, 1815; elected a member of the Essex County Natural History Society, in 1834, and of the Essex Historical Society, in 1843; an original member of the Institute, and died in Salem, Dec. 26, 1895.

Alexander H. Rice, son of Thomas and ——— Rice, was born in Newton Lower Falls, Aug. 30, 1818; elected a member of the Essex Institute, Aug. 20, 1894, and died in Melrose, July 22, 1895.

William G. Webb, son of Stephen and Martha T. (Luscomb) Webb, was born in Salem, in 1833; elected a member of the Essex Institute, Nov. 7, 1870, and died in Salem, May 17, 1896.

Edward Wigglesworth, son of Edward and Henrietta M. (Goddard) Wigglesworth, was born in Boston, in 1841; elected a life member of the Essex Institute, Nov. 19, 1894, and died in Boston, Jan. 23, 1896.

Henry W. Williams, son of Willard and Elizabeth (Osgood) Williams, was born in Boston, in 1821; elected a member of the Essex Institute, Aug. 20, 1894, and died in Boston, June 13, 1895.

Edmund B. Willson, son of Luther and Sally (Bigelow) Willson, was born in Petersham, Aug. 15, 1820; elected a member of the Essex Institute, June 22, 1859, and President for the years 1893–5. He died in Salem, June 13, 1895.

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BULLETIN

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THE PHOTOGRAPH AND SKELETON OF A NATIVE AUSTRALIAN.

BY GEORGE A. DORSEY, PH.D.,
Acting Curator, Field Columbian Museum.

IN March, 1891, the Peabody Museum received by purchase from Mr. A. P. Goodwin a large collection of ethnological objects from Oceania. Among these were the photograph and skeleton of a native of Lismore, who was known as Neddy Larkin. As a perfect skeleton and photograph of an Australian subject in life are not often met with in the museums of this country, Professor Putnam, the Curator of the Museum, placed the skeleton and photograph in my hands for study. Mr. Goodwin's letter, in which he states that he knew Neddy Larkin, saw him buried, and personally secured his skeleton, is on file in the Museum. Thus there can be no doubt that the skeleton is really that of the individual of the photograph.

Lismore is on the Richmond river in the extreme northeastern part of New South Wales. According to an ethnographical map of Fraser, this region of New South Wales is inhabited by the Paikalyug tribe.

PHOTOGRAPH.

Judging from the photograph and skeleton, Neddy Larkin must have been about fifty years old. There is nothing especially noteworthy brought out by the photograph. It presents to us simply a typical specimen of a native of New South Wales. The beard apparently is slightly gray, and evidently has been trimmed quite short. The hair is long and in the usual state of disorder, but seems rather straighter than one usually finds in a native of Australia. The deep set eyes and overhanging brows are quite prominent, and give some indication of the massive superciliary ridges which we find on the skull. The nose is very broad but not flat, and is well shaped. A depression between the lower lateral cartilages of the nose is well marked and has almost the appearance of a slit in the nose. The body is not so lean as is usually the case with Australians, judging from several photographs before me. The arms are covered with long, thick hair, and hair can be seen thickly scattered over a small area high up the breast. The body below the waist is not visible. In the left hand is held a rough boomerang. On the upper left arm (the upper right arm is hid by the fore-arm) and on the breast are plainly seen the usual marks of adornment — long straight brands or scars. They run entirely across the breast at close intervals, the highest one being placed just above the mammæ. At least seventeen lines are visible and there may be more which can not be seen. On the arm thirteen scars or "mom-bari" are visible; they run lengthwise and are about eight

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inches in length. The primary significance of this peculiar form of tattooing is not known and has been forgotten even by the natives themselves. Concerning the method of operation, Frazer says "the brand is cut with a piece of flint or of a glass bottle in some simple pattern; the cuts bleed a good deal, and to make them deeper the knife is applied again and again. While the wounds are still open, hoar frost is rubbed in, or charcoal, and that causes well-marked ridges to remain permanently there. The thing is done when the person is young, perhaps from 6 to 12 years of age."

The anterior edges of the sterno-cleido-mastoid muscles are unusually prominent and make a well-defined depression between them.

SKELETON.

The skeleton is almost complete, only a few of the terminal phalanges being missing. The extremities of both hands and feet have a charred appearance as if from having been in fire. Otherwise the skeleton is in good condition. The length of the entire skeleton is 1616 mm. which with 35 mm. for the soft parts would make 1651 mm. for the stature of Neddy Larkin. In taking the height of the skeleton I followed the method employed by Dr. Dwight and fully described by him in the Medical Record of Sept. 8, 1894.

Examining the length of the long bones we have the following measurements:

Humerus	272	mm.
Radius	253	
Ulna	272	
Femur, oblique length	440	
Tibia, maximum length	381	

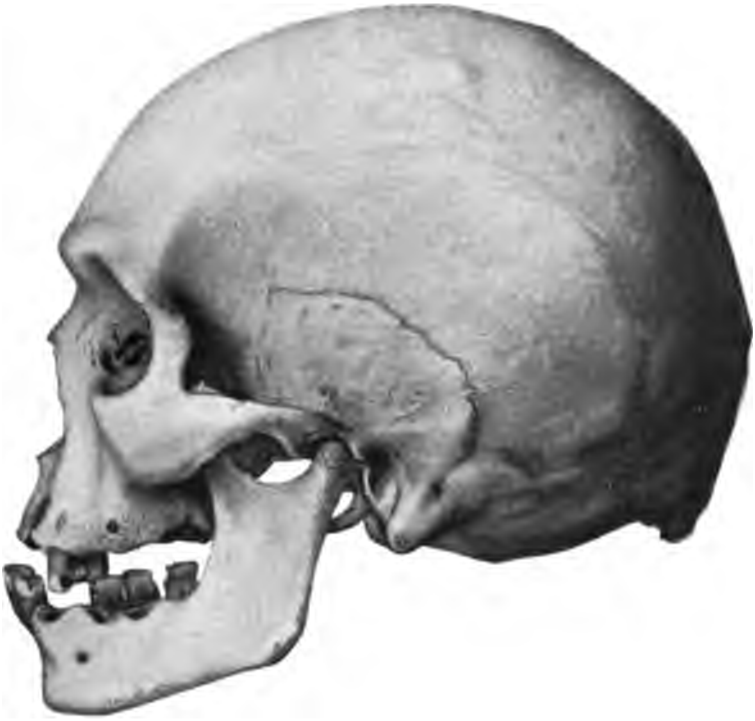
From these measurements some interesting observations can be made. The proportion of the humerus to the total length of the skeleton is 20.3 which is even greater than that given by Humphrey for Bushmen. The relation of the radius to the stature is 15.6 which is approximately the figure given by Hovelacque and Hervé. The relations of the femur and tibia to the skeleton are 26.8 and 23.2 respectively. The antibrachial index is 80.3 which is very high, and approximates that of the higher apes more closely than does the same index in the African negro.

The torsion of the humerus is 136 degrees. According to Hovelacque and Hervé, the degree of torsion of the humerus in the human family is lowest among the Australians.

SKULL.

The skull is remarkable in many ways. The general surface is very smooth and it is almost impossible to make out any muscular ridges. In addition to the sutures which are normally closed in an individual of this age, the following are more or less completely synostosed: the coronal, sagittal, lambdoidal, spheno-frontal, spheno-parietal, malo-zygomatic, malo-frontal, nasal, naso-maxillary, intermaxillary, palato-maxillary and interpalatal. The original degree of serration of the cranial sutures cannot be determined.

Norma lateralis.—There is a considerable amount of alveolar prognathism, rather more than one usually finds in an Australian skull. The teeth are nearly horizontal. The nasal spine is heavy and prominent, a character not usually associated with the lower types of crania. The nasal bones are not prominent. The glabella, while very highly developed, is entirely obscured by the enormous development of the superciliary ridges. The inion is equally massive and projects downwards so that it supports the posterior region of the skull. The mastoid processes are not prominent. The temporal ridges can



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no longer be distinguished. A faint spheno-parietal suture can be made out about 4 mm. in length, which gives the so-called pterion in H. The curvature of the vault of the cranium is very gradual, the curve of the frontal region passing imperceptibly into that of the parietal; in type it approaches the Neanderthal. The external auditory meatus is unusually large and is elliptical in shape.

Norma verticalis.—With the skull in this position its extreme length and the narrowness of the frontal region are very striking, while the prominence of the supra-orbital ridges is equalled by that of the external angular processes of the frontal bone. The parietal eminences are small but well marked. There is nothing which approaches the parietal crest which often marks skulls of an inferior type. The parietal foramina have entirely disappeared.

Norma frontalis. — From a front view the face seems all orbits and nose, so great are their cavities. The orbits are especially profound and large. The angle of inclination of the transverse diameter seems unusually great. The lachrymal bones are obscured by the frontal process of the maxillary bones and none of the lachrymal sutures can be determined. The infra-orbital groove continues broad and shallow, almost to the orbital crest. On the right orbit is a supra-orbital foramen, on the left side a shallow notch is hardly recognizable. The nasal bones broaden and flatten out very much at their inferior border. The inferior border of the nasal cavity is not sharp as it usually is in Europeans, but is concave so that the nasal cavity is not well defined and passes gradually on to the alveolar region. The maxillary bones are broad, especially through the alveolar region. The canine fossæ are extremely shallow, a character the reverse of the European type.

Norma posterior.—The skull is hypsicephalic or narrow and high, but not to an extreme degree as is usually the case with Australian skulls. The region just above the occiput and below the parietal eminences is slightly flattened. The transition of the posterior region is very marked at the region of the inion where the occipital bone passes forward very abruptly.

Norma inferior.—While the external occipital crest is fairly prominent, no trace of the inferior curved line can be made out. The digastric and occipital grooves are very deep and pronounced and the foramen ovale seems to be of unusually large size. The zygomatic arches stand out prominently and the prognathism already spoken of is seen in the distinct forward slant of the alveolar process. The surfaces of the alveolar process are broad and are more or less absorbed, especially in the regions of the incisors.

From a morphological consideration of the skull we pass to the craniometric characters. The following measurements were taken:

Capacity	1290 cc.
Maximum length	191 mm.
Maximum breadth	131
Height, basion-bregna	140
Index, length-breadth	69
Index, length-height	73
Minimum breadth of forehead	98
Breadth of base	102
Height of face, nasal point-alveolar point (A)	71
Height of face, nasal point, mental point (B)	118
Breadth of face, bi-zygomatic diameter	131
Index face (A)	54
Index face (B)	90
Height of nose	50

Breadth of nose	32 mm.
Index of nose	64
Height of orbit	38
Breadth of orbit	44
Index of orbit	86
Length of palate	52
Breadth of palate, between lateral canines (A)	32
Breadth of palate, between 2nd molars (B)	43
Index of palate (A)	61
Index of palate (B)	82
Mandibular angle	124
Basi-alveolar length	100
Basi-nasal length	97
Index of alveolar gnathism	103.9

The capacity, 1290 cc., is somewhat higher than that usually given for Australians, Turner giving 1230 cc. and Quatrefages and Hamy, 1269 mm. The cephalic index of 69 proves the skull to be longer than the average, Quatrefages and Hamy, and Broca giving 71. The vertical index is about the average for Australians.

Both facial indices indicate a short, broad face, a characteristic trait of Australians. The nasal index of 64 is unusually high, the average among the Bushmen being only 60, while the average for the Australians is 57. The orbital index also is unusually high, 80 being the average. The two palatal indices show the palate to be of a very low type, the posterior diameter being proportionally much greater than the anterior. The other measurements do not merit special comment. To conclude with the skull, it is notable for its amount of synostosis, small capacity, pronounced dolicocephalism, mesoseme orbits, platyrhine nose, broad palate, and prognathism.

Teeth.—The incisors, right canine, both 3rd molars, and the left second molar of the upper teeth, and the first and second premolars and all the molars of the left side of the lower teeth were lost during life and the alveoli are considerably absorbed. Of the upper teeth there now remain only the premolars of the right side and the canine and first premolar of the left side; of the lower teeth there yet remain the incisors of the left side and the three molars of the right side. The crowns of the teeth are very much worn down, especially those of the front teeth. The wear on the lower lateral incisor has been from side to side and not from before backwards. The degree of wear corresponds in general to No. 3 of Broca's scale. Every one of the nine teeth present is more or less affected by caries, these being unusually large in the molars of the lower jaw.

TRUNK.

The vertebræ and ribs are of the usual number. The first rib is extremely short and atavistic, even after making due allowances for the general slightness of the skeleton. The sternum presents no peculiarity whatever. Like the other bones of the skeleton it is slight, short and very narrow. The length of the manubrium is 47 mm. and the greatest width 50 mm. The length of the body is 99 mm. Thus the general rule prevails here, the body of the sternum in males being a little more than double the length of the manubrium. The clavicle is short, thick, massive and only measures 118 mm. in length, whereas a length of 145 mm. for a European clavicle would not be excessive.

Scapula.— The body of both right and left scapulæ is exceedingly delicate and thin, so much so that there occur, especially in the left, numerous irregular foramina, there being one in the supra-spinous region with a diameter of 15 mm. There is also, in the left scapula, a large oval foramen in the centre of the spine just where it is differentiated from the body. In the same bone the configuration in the region of the suprascapular notch is very peculiar, and deserves a brief notice. This notch in Europeans is generally well differentiated and lies just at the posterior border of the base of the coracoid process. In the anthropoid apes a distinct notch does not appear at all, there being simply a gradual curve along the entire superior border. Now in the left scapula we find neither the notch nor the gradual curve. Instead there is a prolongation of the anterior process to within 10 mm. of the base of the spine, then it projects backwards and slightly upwards for a distance of 8 mm.; then it passes upwards and decidedly forward and reaches the crest of the spine. Thus there is formed a squarish notch, the sides of which measure approximately 10 mm. and the posterior superior edge forms with the border of the body proper an extremely acute angle.

This same region on the left scapula is not so anomalous but is of perhaps greater interest, for there is not a notch at all but a clearly defined parabolic curve, which in no wise differs from that of the scapula of the orang.

There is yet another peculiar difference to be noted between the right and left scapula. In the right scapula the external border is decidedly T shaped almost throughout, the outer border being 10–12 mm. broad, but there is no abrupt increase in width as we approach the acromion as is usual, but instead only a gradual widening until the end is reached, where there is the maximum width of 25 mm. The termination of the process is squarish and only projects 22 mm. beyond a line perpendicular to the glenoid fossa. The spine of the left clavicle is decidedly heavier and more massive in every way, and its termination is more typical of the human form than that of the left. The tip of the external border of the acromion extends beyond the plane of the glenoid fossa about 40 mm. or nearly twice as far as it does in the right clavicle. The coracoid processes are approximately the same in both specimens, except perhaps that that of the left is a trifle more massive. The superior third of the subscapular fossa of the right bone is decidedly more concave than the left, so much so that the supraspinous portion turns sharply forward at an angle of about 45 degrees.

There remains to be noted the character of the inferior borders with their angles. Without attempting to give the degree of the angle with accuracy, for that is well nigh impossible, I may say it is evidently under 35°, which is about the minimum average for man. But the interesting point to note is the fact that the axillary and inferior vertebral borders are nearly straight and form an angle with approximately straight sides, so that there is little difference in this respect from the orang's scapula.

When we consider the measurements of the two bones singularly there is no apparent difference between them, so they may both be given together. The measurements are as follows:—

Breadth	102 mm.
Length	145
Infraspinous length	116

From the first two measurements, there is obtained the scapular index, which in this case is 70.3. This is considerably higher than the average in Europeans, which is about 65. It agrees pretty nearly, however, with the index given by Flower and Garson for Australians and other inferior races, and corresponds to the figure given by Broca for the gorilla. Perhaps of still greater interest is the infraspinous index. Here, according to Dwight, the lowest of the gorilla and chimpanzee exceeds the highest infraspinous index of man. The infraspinous index of the scapula under consideration is 80. This is exceptionally low, even for very inferior races.

The left scapula has the singular distinction of bearing a rifle ball of lead deeply imbedded and partially covered by new bone growth, in the subscapular fossa just beneath the neck of the spine.

Pelvis.—The individual varieties of the pelvis are so great even in the same race that it seems almost useless to give the measurements of a single specimen. Yet any observations on a skeleton without taking into consideration those of the pelvis, would be decidedly superficial. The pelvis as a whole is remarkably slight and compact. The width between the iliac crests, the maximum width of the pelvis, is 255 mm. which is about what we should expect, considering the general slightness of the entire skeleton. The measurements of the true pelvis are as follows: Antero-posterior diameter 110 mm., transverse diameter 111 mm. This gives approximately 100 as the pelvic index, which is about the usual thing in males—in females the transverse diameter is appreciably longer, relatively, than the antero-posterior diameter, so that the usual pelvic index is somewhat less than 100 for females. The width between the tubersites of the ischia is 118 mm. Of the other numerous and less important measurements which might be taken on the pelvis, I have made only three. The first two are the maximum height, 188 mm., and the maximum width, 158 mm. With these we obtain the height-index of the pelvis which in this case is 80.3.

Sacrum.—The sacrum possesses the usual number of vertebræ, five, and is characterized by its length, which is a feature common to Australians and other inferior races. Its maximum width is 96 mm. while the maximum length is 101 mm. This gives a sacral index of 95. For the maximum diameter to be less than that of the length is the rule in males, but the index 95 is rather low, even for Australians, as 99 is usually given as the average index and 94, according to Turner, is that of the Andamanese. The average sacral index in the European male is about 112, while that of the anthropoid apes is as high as 87 in the orang. Thus here we have evidence of a low type of skeleton.

LIMBS.

The length of the limbs has already been given. The diameter of the head of the femur is 43 mm. which is considerably less than what we should expect. The neck of the femur is very short, measuring only 21 mm. on the dorsal side. The right tibia is peculiar in that there is a high ridge or crest which surmounts the spinous process of the head and rises to a height of 3 mm. above the lateral tubercles. The fibula is curiously shaped and can be described with great difficulty. Its posterior border is very sharp and this sharp edge extends to the centre of the bone. The inner and especially the outer surfaces are highly concave; in a cross section of the upper extremity it would present an inverted T shape, while toward the centre it is more nearly five-sided, the three larger surfaces being decidedly concave. The humerus is not perforated. The head measures but 39 mm. in diameter.

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INUNDATION IN COVENTRY IN 1607.

The Cittie of Coventrie is situated upon the mount or rysing of a small hill, uppon which place there arose a most strange and dreadfull sodaine inundation, the manner whereof followeth, word for word, as I received it, under the Seale of the Cittie, and signed by Henrie Sewell, Maior of Coventrie.

"Know ye, that we aswel of our owne knowledge, as of the creditable report of our honest neighbors, Cittizens of Coventrie, who have sustayned great losses lately by a sudden floud, which unexpected and suddenly came first into the Suburbes of the Cittie, from whence or where the rayne that caused that sodaine floud, came, we know not, but uppon Fryday morning, being the 17th of Aprill, 1607, about seaven of the clocke, no man suspected any such floud to be, and suddenly between eyght and nine of the clocke that morning, there was a great floud comming towards the Cittie, where upon some seeing it came halfe a myle of, and made it knowne unto some Cittizens to make present hast to save some of their goods, but the water came so abundantly, like the surges of the sea, into the Suburbes and Cittie, that it rose within one houre in some places, three yards, and better in height, more than it was that morning, and overflowed divers medowes, and grounds, & entred through the streetes and houses of the Inhabitantes that dwelt neere the river, to the number of two hundreth, fiftie, and seven houses, besides worke houses, and other houses of office, neere the river, to the great hurt of Tanners, Whittawers, Dyers, Bakers, and Bruers, not only in their household goods, but in carrying away many things, to their great loss and damage."

In witnesse whereof, we have here unto put the common Seale of the Cittie, for such like causes, ordayned the xvij of May, 1607.

Henrie Sewell, Maior.

SOME RESOURCES FOR PROTECTION AMONG REPTILES.

BY REV. WM. P. ALLCOTT.

THE changes of color in our common tree-toad are recognized in its specific name *versicolor*. In one found upon a growing orange bush, the upper surface was very green. On a window sill of white the conformity to that color is remarkable.

These creatures being abundant in the oaks surrounding my Boxford parsonage, the writer in 1882 tried a few experiments which, unless such work has already been done, may suggest to some one more thorough and exhaustive study of a matter broader in its relations and interest than might at first appear. What I did was this: Glass jars were lined with leaves, bark, paper or other material. Thus chambers were secured of various colors — *gray* with the bark of red oak, *green* with the leaves, *buff* with decayed birch wood or dead foliage, *blue*, *red*, *white* and *black*, which we may here count as a color. It was found that a confinement of at least twenty-four hours and sometimes of several days was needful to secure the full change.

The same toad was successively placed in these different jars. My notes were too meagre and I am not sure that I tried more than one *Hyla*. The results were as follows: in his blue room my patient was very *green*, and in his red one less green with patches of reddish hue and some of buff. The other colors of my upholstering he copied more closely, except that in the white chamber he was very green with markings that were almost black. This seemed very strange because, on white surfaces, these batrachians usually conform to them in color, and because with buff there was no green but only shades of light ash. With the darker colors, his hues were generally tones of dark ash.

The markings upon the back remained more or less manifest throughout, but in the green and blackish state merely as a deeper shade of the same color. Thus, in general, I find that the color of the back varies from almost white to a dark ash and from these colors to a leaf green. The buff or reddish patches referred to seemed like an effort towards an unusual result. No alteration of the colors of the toad's inferior surface was observable. Doubtless the effects from exposure on a plain surface of color would differ sometimes from the chromatic changes which come by transmission of light more than by reflection from below. Whether these changes are occasioned through the retina, or by some more direct influence on the epidermis, might perhaps be determined by a simple experiment but one which seemed too cruel for the writer to make. Can it be questioned that all this variation of color is protective and has its relation to discussions on evolution?

The tree-toad, wherever it may be, is difficult to discover. You may hear its note near by, but clinging closely to a limb, where it is usually found, its flattened body conformed in color to the bark and less noticeable for the markings, which simulate lichens and the irregular lines of fracture and shade, it seems only a knot.

This Hyla also has a way of dodging underneath and around its perch and one or two more resources that I have observed. The renal excretion in this and other reptiles may possibly surprise and disgust fastidious enemies and perhaps the sudden and rattling note of the creature may awaken hesitation and allow escape. When, as a boy, I spent much time in the trees around our house, I was often surprised at the abandon with which these little creatures would jump from the very topmost boughs to escape me. Usually they caught on something as they fell. But when they came down on the gravel path they were not harmed—apparently not even by a moment of stomach-ache! A precipitate leap, then, is a last resort. Except for these and other resources, various birds might count *Hyla versicolor* LeC. a frog for an epicure. I may add one incidental observation on this reptile, namely, its singular unwillingness to get into water. For a creature that has been a tadpole and so recently left some pond this seemed strange, and others may determine whether it is always subject to such a *hydrophobia*.

Some changeableness of color is observable in the familiar toad. In a manure cellar or on the black loam of a swamp he will be almost a negro. Living on light-hued gravel he will be a Caucasian. A very black specimen which I put in a box of white paper changed remarkably in a few days, but not so rapidly as the Hyla.

It is doubtless true that to some extent many other creatures vary in a similar way according to the surfaces on which they live. Whether or not human disease of mind and body may be alleviated by living in light of certain colors, we know that our "animal spirits" vary with the weather. A long period of clouded sky has a depressing effect on most minds. The influence which comes from companionship is a fact of not very remote connection. It would hardly seem that the dark skin of the Ethiopian or the Arab could be explained by tropical forests or darker terrestrial surfaces. Possibly it might be argued that ages of residence under a luxuriant vegetation evolved the negro skin and that the modifying influence of desert life is seen in the brown of the Bedouin. But where did we get *our pale skin?*

That the psychological influence of mountainous or prairie regions, sea-girt coasts, dense silvas or alpine snows may affect national character is a common and plausible theory — but we have wandered from reptiles.

Our *Bufo Americanus* LeC. is protected from enemies not only by some variation of hue and diurnal repose, but also by an acrid skin and a way he has in extremities of swelling himself, stiffening his hind legs, arching his back and bringing his head to the ground about in the position by which the small boy was formerly instructed to frighten off a mad bull! The toad adds to these strange doings a guttural croak and altogether makes himself so *uncanny* that even a starving crow might well fear to swallow such a possibility of being "hoist with his own petar." These creatures, like many others, find obvious protection in prolific breeding.

Our graceful and beautifully colored ribbon snake, *Eutænia saurita* B. and G., has a device for escape that I have often noticed. When capturing these creatures I have been wont to take them by the tip of the tail. As soon as this snake discovers the hopelessness of escape by other means it will swing itself around in a circle till it twists off the tip which is held and thus, if possible, escapes. The gyrations, so far as I observed, were always in the same direction — from left to right, unless my memory is at fault.

Sitting under a tree, one summer afternoon, like a flash two somethings passed within a yard of me, and paused just beyond in the taller grass, near bushes. I saw immediately that the second apparition was a ribbon snake. With body elevated for half its length or more, quickly turning head and sparkling eye, it was beating the grass for a "leopard frog" which, with croaks of distress and immense leaps, had made for this "cover." My investigation was a benefit to the *batrachian* who made good his escape. If ever I saw anger with myself, it was in the eye and mouth and actions of that serpent, which at first stood his ground and seemed ready to "give it to me." The whole incident awakened a new impression of the intelligence of reptiles, which doubtless is more of a protection to them than we are aware.

Tenacity of life is to be counted as another resource. The diffusion of the vital principle among ganglia and nerves scattered through the body, is the reason why they are so difficult to kill, and recover from such severe injuries and perhaps may explain why they sometimes return to life after having been frozen.

When a student, the writer once undertook to dissect a land tortoise, *Glyptemys insculpta*, Ag. He attempted to put the creature to death with strychine and arsenic, which were apparently of no effect. Cyanide of potassium brought some blood from the reptile's mouth and seemed to cause pain. To end suffering decapitation became necessary, and finally I was obliged to open the body while ganglionic movements continued. Under these circumstances I removed the heart and placed it in a dish of water. There it continued to pulsate for a number of minutes, both its movements and the small discolored current of water being plainly visible. Certainly I ought to have timed the continuance of this action.

My little boy has had a specimen of Blanding's tortoise, *Emys meleagris* Ag., for over a year. It was about half grown, being four and one half inches in length. Late in the fall, I buried this "turtle" under a foot or more of dry earth placing him on soil at the bottom of a keg in the cellar, and pouring more soil over him. In a day or two, Mr. *Emys* was crawling on top of his covering. Then I buried him in mud but he was soon treading it under his feet. So in despair I put him in his old tub moved to the cellar, with opportunity to stay in the water or out of it as he pleased. He chose the former course. For some weeks he showed signs of life. Then he retreated into his shell, closed it, and remained apparently dormant for several months in the water which did not freeze.

In April last, we brought him out and offered him living earth-worms, the only thing we ever found that he would eat. He refused to touch them for several weeks, but gradually his excellent appetite returned. It was the same with a "wood-chuck" which at about the same time we brought up from his winter's sleep in a barrel. At first he would not touch his tid-bits but after a number of days he awoke to full life and activity.

A full-grown Blanding's tortoise, which we kept for several weeks would never eat anything — perhaps from continued fear, perhaps because he "had his growth." We have sometimes kept "mud turtles" through the entire summer and released them when the first ice came, vigorous but somewhat thin in flesh(!) without their having taken once during this period any visible nourishment. This ability to endure abstinence may perhaps be included under our subject.

ROGER WILLIAMS IN SALEM.

A PAPER READ, OCTOBER 9, 1894, BEFORE THE LOCAL HISTORY CLASS OF THE ESSEX INSTITUTE.

BY MRS. HENRY M. BROOKS.

FROM my earliest childhood, the name of Roger Williams was synonymous with Baptist. I thought he was banished from Salem by Salem people because he was a Baptist and the rigid Puritans would have no person in their dominions who differed from them in any religious doctrine. I was not alone, for I find that was a common belief among those who had never looked into the matter historically. In reading the various accounts and lives of Roger Williams written in his own and down to the present time, I do not find any authority to prove that he ever, while in Salem or Boston, did or said anything which would show that he even knew of the existence of such a sect. He was sometimes called an Anabaptist which was used as a term of reproach and was applied indiscriminately to all who differed in any essential points from the rigid Puritanism of the day. He did probably object to infant baptism, not finding any scriptural authority for it; but so did many others, including President Dunster, President Chauncey and other noted men. In 1638, after his banishment and when he was in Providence, which place he made a refuge for dissatisfied, freethinking and persecuted persons, he met with some settlers who called themselves Baptists and Straus says: "It is not surprising that Williams should have felt a leaning toward this sect which throughout its entire history preached the gospel of love, abhorred and abstained from persecution and preëminently maintained the rights of conscience." Williams was baptized by one Ezekiel Holyman and then baptized ten others. "This event has been generally looked upon as the establishment of the First Baptist Church in America." But Williams could not be contented with any creed which did not admit of full liberty of conscience and was connected with this church only about four months. For the rest of his life, more than fifty years, "he did not acknowledge himself as belonging to any denomination."

After this long prelude in regard to what Roger Williams was not, I will give a little sketch of his early life and opinions.

Of Roger Williams' very early life and parentage there has been but little known. Until lately it was supposed that he was a Welshman and educated at Oxford, similarity of names being very confusing, but our fellow-townsman Mr. Henry F. Waters, who is usually correct and who leaves no stone unturned, has come to the conclusion that he was born in London, in 1607, the son of James and Alice Williams; that he was elected a scholar of the Charter House School June 25, 1621, and passed from there to Pembroke College, Cambridge, June 29, 1623; from which college he took his degree in 1626. At any rate he was a well educated man and was versed in five languages besides his own — French, Dutch, Latin, Greek and Hebrew. He early attracted the attention of Sir Edward Coke, the eminent jurist, who was always his patron and friend. Mrs. Sadlier, Sir Edward's daughter, says "as a youth he would in shorthand take sermons and speeches in the Star Chamber and present them to my dear father." After leaving college he studied law for a short time, but theology was nearer his heart and he soon became a decided opponent to the ceremonies of the church. Even in his young days he had discussions with Hooker and Cotton upon the use of the Common Prayer. "His mind was enriched and expanded with the best learning of the age." The great controversy which divided the English Church was at its height; he thoroughly studied the principles at issue and early placed himself upon the Puritan side. But he went beyond the Puritans: he was firmly convinced that conscience should be free, that no person should be responsible in matters of belief to any other person or persons, but to God alone. He naturally looked to New England as a haven for disaffected people in England and sailed with his wife Mary on the 1st of December, 1630, in the Lion, Captain Pierce, for Boston where he arrived after a long and stormy passage on the 5th of February, 1631.

Roger Williams supposed he should find a state of society in which "he could express the great doctrine which had taken full possession of his soul," but he soon found that freedom of conscience was not allowed. Gammell says "It is a mistake, as has been often remarked, to suppose that they [these Puritans] came to New England with any notions of unlimited freedom of conscience." "It was to escape oppression for themselves, not to secure the boon of freedom to others."

Mr. Wilson, the minister of Boston, being about to return to England for a short period, it is said that Mr. Williams refused a call to preach to the people of that place in his absence on the ground that they were an "unseparated people." At any rate he did not unite with the people of Boston, but in a few weeks was invited by the people of Salem to become an assistant to Mr. Skelton, Mr. Higginson having lately died, which call he accepted. This drew upon Salem a letter from the General Court warning them of his heretical views, the chief of which was that magistrates had no control over the consciences of men, that their power extended only to breaches of the second table, that is, the duties of man to man; whereas the duties of man to God as stated in the first four commandments were questions not to be interfered with; that every man had a right to follow his own inward light. This was a great error in the minds of these Puritans. The Salem people paid no attention to this letter, but settled Mr. Williams immediately on the 2d of April, 1631. He found his situation, however, very uncomfortable as he was constantly watched and his remarks criticised. Dr. Bentley says "Persecution instantly commenced and before the end of the summer he was obliged to retire to Plymouth." Here he was well received, preaching sometimes as an assistant to the Rev. Ralph Smith and supporting himself chiefly by manual labor, "at the How (hoe) and at the Oar for bread." He associated much with the Indians, studying their language and habits; and sought in every way to do them good. This was of great use to him and to all New England in after life, for the Indians always regarded him almost as a sachem. He says he "had a constant zealous desire to dive into the native language." He published in later life, in 1643, his "Key to the Indian language." He staid in Plymouth about two years, but his heart yearned towards Salem and the Salem people; and accordingly in Aug., 1633, he returned there as assistant to their pastor, Mr. Skelton. During the year following he seems to have been constantly harassed by the magistrates and was several times summoned to appear at the General Court in Newtown, now Cambridge. Whatever occurred at Salem displeasing to the ministers or magistrates of the Colony was attributed to Williams and he was held accountable. He continued to preach what seemed to him the truth. He objected to an oath being required of any man, particularly an unregenerate man, as taking the name of God in vain. He denounced, as an open violation of natural rights, the law which required every man to attend public worship and to contribute to its support. "No one," said he, "should be bound to maintain a worship against his own consent."

While in Plymouth he had written a treatise which he had presented to the Governor there, showing that kings and countries had no right to claim a land by right of discovery; that, if the land was owned at all, it was by the native inhabitants and should be bought of them; that patents and grants were of no value unless paid for; that King James had no right to call Europe Christendom or the Christian World. The great point which lay heavy on his mind was that, according to the patents, "Christian Kings (so called) are invested with a right by virtue of their Christianity to give and take away the lands and countries of other men." "If the King possesses no jurisdiction over the Indians he could not of course convey a title to their lands."

This paper had not been published and was not intended for the "public eye," but the magistrates averred that it contained "heresy and sedition," and arbitrarily summoned him to appear before them and receive censure. He complied, and wrote letters to the magistrates alleging that his treatise had been written "only for the private satisfaction of the Governor of Plymouth" and with expressions of penitence if he had done anything wrong;

and, though without renouncing his opinions, he offered his book to be burned.

Mr. Skelton, whom Mr. Upham calls his "faithful defender," died in the summer of 1634 and the Salem Church immediately invited Mr. Williams to be its pastor. Again the Court interfered and sent a mandate to the Church that it should not ordain him. Whether the magistrates in Boston had a right thus to interfere has been a cause of much contention.

The Church gave no heed to this injunction, and Roger Williams was regularly installed in Aug., 1634. The independence of the Salem Church was not allowed to go unpunished. From this time forth the Salem Church and Mr. Williams were in constant collision with the authorities.

"In Salem every person loved Mr. Williams. He had no personal enemies. All valued his friendship. He was not afraid to stand for truth against the world. He knew man better than he did civil government. He was a friend of human nature, forgiving, upright and pious." "His preaching was faithful, his doctrines on all the great essentials of Christian faith were sound and his life was of blameless purity." Moreover "Salem began to enjoy unrivalled prosperity and to entertain the proudest hopes." Boston appears to have been jealous of Salem. "It was feared that, in connection with other causes, his resolute spirit and popular talents would give an importance to that town [Salem] that might eclipse the metropolis."

Finally, came the climax. In March, 1635, the people of Salem petitioned for some land between Marblehead and the Cliff, which they said belonged to them, but the Court, as a punishment for contempt of authority in settling Mr. Williams, refused to allow the claim; for in this community of saints it was not " State controlling the Church, but Church controlling the State." The people of Salem felt this to be a grievous wrong and wrote to other churches in the Bay to instruct their delegates to vote differently. This, as there were no newspapers, was all they could do; but it seemed to the magistrates like open rebellion and accordingly the Salem deputies were deprived of their privileges and disfranchised till ample apology had been made. Mr. Endicott, their principal deputy, was imprisoned for his adherence to the doctrines of the letter.

The ministers, with Mr. Cotton and Mr. Hooker at their head, sent a committee to Salem to deal with Mr. Williams, but he disowned their " spiritual jurisdiction." Then the ministers, at the request of the Court, assembled to consider his case, and to give their advice to the magistrates. They " professedly declared " that he deserved to be banished from the colony for maintaining the doctrine " that the civil magistrate might not intermeddle even to stop a church from apostacy and heresy," and that the churches ought to request the magistrates to remove him. In July Mr. Williams was summoned to Boston to answer to the charges brought against him. He was here solemnly charged with the *crime* of maintaining the following dangerous opinions:

1. That the magistrate ought not to punish the breach of the first table, except when the civil peace should be endangered.

2. That an oath ought not to be tendered to an unregenerate man.

3. That a man ought not to pray with the unregenerate, even though it be with his wife or child.

4. That a man ought not to give thanks after the sacrament nor after meat.

Earnest debate followed, and he was dismissed till the next General Court, which was to meet at Newtown, " to consider these things."

In October he was summoned again for the last time. His opinions had not changed. The Court, instructed by the ministers, decided that he should depart out of their jurisdiction within six weeks. The following is the act of banishment as it stands upon the colony records: " Whereas, Mr. Roger Williams, one of the elders of the church of Salem, hath broached and divulged divers new and dangerous opinions against the authority of magistrates; as also writ letters of defamation, both of the magistrates and churches here, and that before any conviction, and yet maintaineth the same without any retraction; it is therefore ordered, that the said Mr. Williams shall depart out of this jurisdiction within six weeks now next ensuing, which if he neglect to perform, it shall be lawful for the Governor and two of the magistrates to send him to some place out of this jurisdiction, not to return any more without license from the Court."

This act of banishment was passed on the 3d of Nov., all the ministers save one approving it.

The Rev. Dr. Dexter, who has written an elaborate and very interesting book to prove, or to endeavor to prove, " the very great wrong done to the memory of the Puritans of Massachusetts" in the case of Roger Williams, gives us a very graphic picture of this " Particular " Court. After mentioning by name the deputies who were probably present, among whom we find many of our old friends of the past summer (the Salem men conspicuous by their absence), he refers to the ministers of the Bay, fifteen in number, twelve of whom were certainly there, nine of them were graduates of Cambridge, and nine of them had held rectorships in the "fatherland." He closes with the following words: "Altogether it was a distinguished company; and it may well be doubted whether the Massachusetts of to-day, even under the classic shades of that great university which marks the spot where this Court was held, now almost as well known to the learned world as is that ancient shrine of knowledge whose scholastic robes so many of them were entitled to wear, could call together out of its hundreds of pulpits twelve pastors and teachers who should be their equals in intellect and worth, and in all those imperial qualities which fit men to be the founders of states."

In Salem the whole community was in an uproar. The time had been extended till spring, but his presence was soon considered dangerous, many of the people resorting to his house to listen to his teachings; the fathers of the colony therefore determined to send him to England. They sent for him to come to Boston but he refused on account of ill health. Nothing daunted they sent a small sloop to Salem with a warrant to Captain Underhill to apprehend him and carry him on board a ship which was to sail immediately for England. When, however, the officers went to his house they found he had gone three days before. It was in January, 1636, that Roger Williams left his home in Salem (still standing) for the wilderness; thirty-five years afterwards he says in a letter, "I was sorely tossed for fourteen weeks in a bitter winter season, not knowing what bread or bed did mean."

Here closes the Salem life of Roger Williams. Never again, in the fifty-odd years more of his busy, useful life was he allowed to visit the people whom he loved so well; once only was he allowed to land in Boston on his return from England, and then only at the intercession of powerful English friends, several noblemen and other members of Parliament.

As his life in Rhode Island has but little to do with our local history, I shall not follow him there, contenting myself with saying that our little sister State may well be proud of its noble founder.

THE CHONDROCRANIUM IN THE ICHTHYOPSIDA.[1]

BY GUY MONROE WINSLOW.

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[1] Studies from the Biological Laboratory of Tufts College, under the direction of J. S. Kingsley, No. XIX.

I wish here to give credit for some of the material used in these studies. The Necturus larvæ were given to me by Miss Julia B. Platt; for Pipa I am indebted to the late Professor E. D. Cope; Professor Robert Wiedersheim furnished me with the Protopterus material and I began the study of the chondrocranium of this Dipnoan in his laboratory. For Amphiuma I am indebted to Professor O. P. Hay, the first to find embryos of this interesting Urodele, and to the late Professor John A. Ryder, who kindly turned over to me the embryos sent him by Doctor Souchon of New Orleans. The embryo Cæcilians were given me by the cousins Paul and Fritz Sarasin and were a part of the material which formed the basis of their splendid monograph. To all these I return my best thanks.

J. S. KINGSLEY.

INTRODUCTION.

The work, the results of which are given in the following pages, has been carried on in the Biological Laboratory of Tufts College, under the direction of Dr. J. S. Kingsley, to whom the author is deeply indebted, not only for the use of much of the material studied, a considerable part of which was already prepared, but far more for invaluable aid and encouragement during the preparation of this paper. It is also due to Dr. Kingsley to acknowledge the free access to his private library containing a large portion of the literature upon the subject, and to state that the models of the first stage of Amphiuma and the three stages of Necturus were made by him.

In my account of the development of the chondrocranium I have not attempted to treat of the origin of the pro-cartilage cells, but I begin with the first formation of cartilage. These earlier stages have been so ably described by Miss Platt ('93, '94) that there seems no necessity to repeat her account, especially as her discoveries in regard to the ectodermal origin of the cartilage-forming cells were largely made in this laboratory, and have received general support and confirmation in the papers of Kastschenko ('88), Goronowitsch ('92, '93, '93^{a}), Klaatsch ('94, '95) and von Kupffer ('95).

One object in these investigations was to ascertain to what extent the primary cranial structures throw light upon some problems in the classification of certain Ichthyopsida. The principal of these problems were these:

(1) By most students the Cæcilians have been recognized as a distinct order of Batrachia, but more recently the late Professor Cope in several papers has maintained that these forms were in reality aberrant Urodeles and

should have only family rank in that order. Summarizing his conclusions, he maintained that the Cæcilians were descended from Amphiuma-like forms and these in turn were offshoots from some amblystomoid Urodele. The cousins Sarasin, while agreeing with Professor Cope in the view that the Cæcilians and Amphiuma were nearly related, regarded the relationship as differing in this respect. Amphiuma was a neotenic Cæcilian, a larval Cæcilian become sexually mature. My problem was to ascertain in how far the chondrocranial structures gave support to any of these views.

(2) The fact that the Dipnoi possess lungs led to the view, which has obtained wide acceptance, that these ancient fish-like forms were the ancestors of the Batrachia, and this view has received no little support from Huxley's short but most suggestive discussion of the suspensorial apparatus in the Ichthyopsida. More recently several students have maintained that the Batrachia have sprung from the Crossopterygian Ganoids and that the only relationship that can be traced between Dipnoi and Amphibians is that the lung-fishes may have had the same ancestry, but that they can in no wise be considered as in the line of batrachian descent. In how far does the chondrocranium support either of these views?

It has not been my purpose to enter the broader field of the relationships of these different groups as is shown by other features. I have confined myself closely to the chondrocranium and my results are to be regarded as merely one factor in deciding these questions; a factor in itself of minor importance.

I take as the basis of my studies the development of the chondrocranium of *Amblystoma punctata*, since of this form I have had the most abundant material. This is followed by an account of certain stages of the chondrocrania of some other Ichthyopsida, and an attempt is made to see how far the chondrocranium can be employed as an aid in the classification of these forms.

The various stages are determined in an arbitrary manner by body length, but it is to be borne in mind that there is considerable variation in embryos and larvæ of the same size. All stages described have been modelled in wax by Born's method, the models have afterwards been carefully measured and compared and all exaggerations of proportion due to slight variations in the thickness of the wax have been corrected in the drawings.

AMBLYSTOMA PUNCTATA.

FIRST STAGE. — *Embryo ten mm. long. Mouth on the point of breaking through* (Figs. 1 and 2). This stage, which I have taken as the starting point of my investigations, corresponds closely with that at which Ph. Stöhr begins his classic account of the chondrocrania of Triton and the Axolotl ('79). The chondrocranial elements are still in the pro-cartilage condition but they are clearly differentiated from the surrounding parts by the arrangement of their cells. Three pairs of elements are present, namely, the parachordals, trabeculæ and the quadrates.

The parachordals (*p*) lie as two triangular plates upon each side of the slightly depressed anterior end of the notochord. One side of each triangular plate is directed anteriorly and the antero-exterior angle joins the posterior end of the trabecula, while the inner face of each abuts against the side of the notochord (*n*). The lateral margin of the parachordal runs obliquely outwards and forwards from its posterior angle to the junction with the trabecula. The parachordals arise separately and at this stage touch only at the sides of the notochord, thus leaving the upper and under surfaces and the tip of the latter exposed.

The trabeculæ (*t*) continue forwards in nearly the same horizontal plane as the main part of the notochord, the apex of which, with the adjoining portions of the parachordals, is slightly depressed. The trabeculæ curve first outwards to a point beyond their middle and then in, their apices being about as far apart as their bases. They end medially to the olfactory organs, a little behind the external narial openings. The lower margin of each trabecula is thickened, while above it is developed into a high and thinner crest (*trc*) inclining slightly outwards. The upper margin of this crest is extremely irregular and the foramina for the optic and oculomotor nerves (*of* and *oc*) are but partially enclosed. The crest gradually increases in height from in front backwards to the posterior end of the trabecula where it terminates abruptly.

The quadrates appear as two thin bands of cartilage external to and at some distance from the parachordals. They are concave anteriorly and their general direction is downwards and outwards. In each quadrate can be already recognized three portions, a middle piece constituting a body (*bq*) from which arise an upper ascending process (*ap*) directed forward, inward and upward toward the crest of the trabecula, and a lower descending process (*dp*) running outward, forward and downward to the articulation with Meckel's cartilage. The body is somewhat lenticular while the processes are thin and more laminate.

Meckel's cartilage (*m*) is already complete. The general course of each ramus is obliquely inward and forward until about the middle point where it curves still more strongly inward to meet its fellow of the opposite side. At its base each ramus is stout but it tapers regularly and is slender at the point of union. A point which seems to me of considerable morphological importance is that the symphysis is considerably behind the apices of the trabeculæ, recalling in this embryonic stage the conditions which are permanent in the Elasmobranchs and lower Ganoids.

SECOND STAGE.—*Embryo, eleven mm. long* (Fig. 3). The parts described in the first stage have chondrified rapidly and two new pairs of cranial elements, the otic capsules and the two processes of the occipital arch, have made their appearance.

The occipital arch (*ocp*) is composed of two isolated conical pieces of cartilage, the bases of which rest upon the sides of the notochord a little behind the otic region. From the notochord they curve outwards and upwards, half encircling the medulla and terminating freely. The incompletely developed otic capsules (*o*) are represented by thin layers of cartilage, very irregular in outline, covering the lateral and portions of the dorsal and ventral surfaces of the auditory vesicles. Their anterior ends lie immediately behind and above the bodies of the quadrates while their posterior ends are somewhat nearer the median line, just in front of the occipital arch. The ventral walls of the two capsules are in nearly the same horizontal plane with the notochord and the parachordals. There are no cartilaginous connections between the capsules and the rest of the chondrocranium.

The parachordals (*p*) have fused with each other at the apex of the notochord and now extend back along its sides to about the middle of the otic region where each gives off a lateral process which underlies the median portion of the sacculus. Although the median wall of the otic capsule is as yet but slightly developed, its future line of fusion with the parachordal is clearly indicated by a longitudinal marginal thickening of the latter.

Accompanying the general growth of the head and the lessening of the cranial flexure, the trabeculæ (*t*) have increased considerably in size, more especially in length. At their anterior ends they have become slightly broadened and flattened to form the cornua trabeculæ (*c*), the first indications of the nasal capsules. The gaps between the disconnected portions of the trabecular crest of the first stage are now filled, forming a plate, the dorsal margin of which is a smooth, undulating line sloping gradually downward in passing from behind forwards. The foramina for the optic and oculomotor nerves are now completely enclosed.

Several noteworthy changes have occurred in the quadrate (*q*). Its body and descending process have grown broader and thicker, and two lateral projections from the latter form a transitory support at the base of the balancer (*su*). At the time of its most complete development this support has the form of a shallow cup, the rim of which coincides with the circumference of the base of the balancer. The ascending process has extended upward and has fused with the posterior end of the trabecular crest. A slight backward projection from the body of the quadrate is the first trace of the otic process.

THIRD STAGE.—*Larva twelve mm. long* (Figs. 4–7). The distal ends of the occipital processes (*ocp*) have fused with the postero-dorsal walls of the otic capsules, and their proximal ends have fused with the posterior ends of the parachordals. A solid floor is thus formed beneath the medulla, and the jugular foramen (*j*) is enclosed by cartilaginous walls.

The parachordals (*p*) with the notochord now form a complete basilar plate below the posterior half of the brain cavity except at one small place (*f*) upon the left side which still remains unchondrified. With the exception just mentioned, the lateral margins of the parachordals are now everywhere continuous with the floors of the otic capsules.

The otic capsule (*o*) now presents the typical capsular form, covering by far the greater part of the surface of the auditory vesicle. The median wall is beginning to form along the dorsal margin and at the two ends of the capsule, leaving two unchondrified spaces in the middle and ventral region; a large anterior one through which pass the seventh and eighth nerves and the endo- and perilymphatic ducts, and a smaller fontanelle lying postero-dorsally to the first. In the floors of the capsules. are the foramina for the exit of the branches of the seventh nerve (*vii*). Upon the left side the two branches of this nerve pass through the two ends of a transversely elongated foramen, while upon the right side they pass through two separate foramina formed by the fusion of the middle portions of the anterior and posterior walls of the originally elongated foramen. Behind the foramina for the seventh nerve and somewhat farther laterally is the large fenestra ovalis (*fo*). The stapes (*s*) which arises from a separate centre of chondrification occupies the anterior end of the fenestra.

The only noteworthy changes in the trabeculæ are a general strengthening and an increase in the size of the cornua (*c*). The quadrate has become more solid throughout all its parts except the processes which were at the base of the balancer in the preceding stage. They have disappeared together with the balancer, leaving a single conical process in the place they formerly occupied. The otic process (*op*) extends considerably farther backwards than before.

FOURTH STAGE.—*Larva thirty-nine mm. long. Gills not yet atrophied* (Figs. 8–11). The ventral portion of the occipital arch is in essentially the same condition that it was in the third stage. So also are the parachordals, except that the union with the capsular floor is now complete upon both sides.

The otic capsules present several new features. From their point of fusion with the occipital processes marginal expansions (Figs. 9 and 11, *loc*) extend medially over the sides of the cranial cavity. Passing forwards they approach each other and unite to form the synotic tectum (*st*) which terminates anteriorly in a short median process (*tm*) the "tænia tecti medialis" of Gaupp. In the median wall of the capsule there are now four small apertures, of which three (Fig. 11) lie in a horizontal row near the floor of the cranium, while the fourth is more dorsal in position. Passing from in front backwards, the first foramen of the row is the one traversed by the seventh and one branch of the eighth nerve (*vii+viii*). The second branch of the eighth passes through the second foramen (*viii*), and the third aperture of the row is traversed by the perilymphatic duct (*pf*). The fourth aperture, higher up in the wall above the foramen for the second branch of the eighth nerve, is the foramen for the endolymphatic duct (*ef*).

At the anterior end of the otic capsule there are three new connecting cartilages joining it with the trabecula on the one hand, and on the other with the quadrate. The process joining the postero-dorsal point of the trabecular crest with the opposite wall of the capsule is relatively slender; while the other two processes, the otic (*op*) and palato-basal (*pb*), are formed by the fusion of a greater part of the dorso-median surface of the body and otic process of the quadrate with the adjacent wall of the capsule and the margin of the basilar plate. A blood vessel, which passes dorso-ventrally around the anterior end of the capsule, is the only line of demarcation between the otic and palato-basal processes. A large chamber is enclosed between the posterior end of the trabecula, the anterior end of the capsule and the bars connecting them dorsally and ventrally. The ascending process of the quadrate passes across its external surface, separating a dorsal and a ventral foramen. The Gasserian ganglion occupies this chamber and from it pass out the ramus ophthalmicus profundus (*rp*) through the ventral foramen, and the rami ophthalmicus superficialis (*rs*), maxillaris (*rm*), and mandibularis (*rn*), through the dorsal foramen.

The foramina by which the rami of the seventh nerve leave the otic capsule are unchanged, except that now there are two upon each side and that they are considerably reduced in size. The fenestra ovalis (*fo*) is now nearly filled by the stapes (*s*), which has a slight prominence directed outwards and upwards from the anterodorsal angle of the cartilage towards the otic process of the quadrate. These cartilages, however, do not become united at any time during the development of Amblystoma as they do in some other forms.

The trabeculæ (*t*) are of nearly uniform size from their junction with the parachordals to the point where they meet in front in the ethmoid plate (*e*). Optic and oculomotor foramina are of equal size, both being small. The ethmoid plate (*e*), arising by the fusion of the anterior ends of the trabeculæ in the median line, forms a continuous floor beneath the anterior end of the cranial cavity, the nasal septum (*ns*) and portions of the olfactory organ. In front it terminates upon each side in a conical process. Laterally a freely ending process (*c*) extends backwards along the ventral surface of the olfactory organ. This and the adjacent parts of the ethmoid plate are developments of the cornua of the earlier stages. In the same plane with the ethmoid plate and just behind its posterior end, a flat antorbital process (*anp*) projects from the side of the trabecula and, curving forwards, terminates directly behind the backward projecting process of the ethmoid plate.

A broad nasal septum rises from the middle of the ethmoid plate separating the two olfactory organs and forming the anterior wall of the cranial cavity. Bars of cartilage, which I have called the tectal cartilages (*tc*), connect the antero-dorsal points of the trabeculæ with the opposite points of the septum, roofing over the olfactory foramina and forming the bases from which curved processes, laminæ cribrosæ (*e*), extend outward, downward and forward, covering over the posterior ends of the olfactory organ.

The quadrate (*q*), besides its fusion with the otic capsule as already mentioned, now presents a well developed pterygoid process (*pt*), a cylindrical rod of cartilage joining the main part of the quadrate at the point where the ascending process meets the body. Its general direction is forwards, parallel with the trabecula as seen from above, and downwards with a slight outward curve near the tip which lies just below the ventro-median surface of the orbit.

FIFTH STAGE. — *Young Amblystoma sixty-nine mm. long. Gills entirely atrophied* (Figs. 12–13). At this advanced stage in the development of Amblystoma, ossification has occurred to so great an extent that large portions of the older cartilages have disappeared, giving the chondrocranium a broken and ragged appearance, especially in the otic region. The median capsular wall, the anterior end of the basilar plate and portions of the occipital arch, and the trabeculæ are entirely replaced by bone. At the same time the whole skull has increased in breadth as compared to its length.

The synotic tectum (Fig. 12, *st*) is completely separated from the remnants of cartilage forming the otic capsules, and the basilar plate (*p*) is reduced in length to little more than that of the tectum. Ossification has removed nearly all of the cartilage of the capsule behind the posterior end of the fenestra ovalis where the stapes is now closely applied against the remnant of the cartilaginous wall of the capsule.

The quadrate (*q*) has undergone important changes, due in part to ossification and to the lateral expansion of the skull. Its body is thicker antero-posteriorly and stands out farther from the capsule. The descending process is cylindrical in shape, presenting greater definiteness of outline than previously. Irregular perforations of the cartilage occur along the line where the quadrate joins the capsule. Most striking of all is the change in the position of the pterygoid process (*pt*) which, instead of being nearly parallel with the long axis of the skull as in the previous stage, now slants from its base outwards at an angle of about thirty degrees from that axis.

The cartilaginous nasal capsules have reached their highest stage of development and present many new and important features. The nasal septum (Fig. 12, *ns*) is narrowed down to about half its former width. In front it divides into two doubly curved plates which extend forwards and outwards to the cup-like anterior ends of the capsules. From the ventro-median surface of each of these plates a short knob-like process extends forwards and terminates the capsule anteriorly.

A flattened band of cartilage which I have called the ventral process (*vp*), in contradistinction to the dorsal process (*d*) to be described later, passes backwards from the ventral margin of the cup-like anterior end of the capsule. At its posterior end this process fuses laterally with the lamina cribrosa (*l*) while medially it terminates in a process projecting freely backward (Fig. 13, *vp*).

The cylindrical dorsal process (*d*) extends diagonally across the anterior end of the olfactory organ from the dorso-median margin of the cup to the anterior end of the lamina cribrosa. A short connecting rod joins the dorsal process and lamina cribrosa with the ventral process in front of the nasal duct (*nl*). As in the preceding stage, the lamina cribrosa forms a roof over the posterior end of the olfactory organ. It now reaches downwards to meet the outer end of the antorbital process thus enclosing the orbito-nasal foramen (*on*), and outwards and forwards to meet the ventral and dorsal processes as described above. It is perforated near the lateral margin by several small foramina through which pass a branch of the ophthalmicus profundus (*rp*) and some small blood vessels (*b*). A branch of the nasalis internus (*ni*) passes out of the capsule through the foramen in its median wall.

DESMOGNATHUS FUSCA (Fig. 14).

The chondrocranium of *Desmognathus fusca*, of which I have modelled two stages, presents so great a similarity to the earlier stages in Amblystoma that only a few words need be devoted to it. Figure 14 represents the model of the skull of an embryo about twenty mm. long.

The parachordals (*p*) are represented by three narrow bands of cartilage; one extending between the posterior ends of the otic capsules and having the notochord partly imbedded in it, and two other bands which connect the apex of the notochord with the posterior ends of the trabeculæ.

The entire absence of a stapes in the history of the chondrocranium is the only noteworthy point of difference between the formation of the ear capsules in Desmognathus and in Amblystoma. The trabeculæ and quadrates present conditions essentially the same as those of a corresponding stage in Amblystoma, but owing, in part at least, to the early appearance of the bony skull in Desmognathus no complex nasal capsule is formed. The simple condition shown in Fig. 14 is the highest state of development reached by the anterior ends of the trabeculæ. A small antorbital process develops in the usual place upon the side of the trabecula. No pterygoid process of the quadrate appears in either of the stages modelled. As the older stage presents a state of development approximately equivalent to that found in the fifth stage of Amblystoma the appearance of this process as figured by Wiedersheim ('77) must be a comparatively very late occurrence.

PLETHODON GLUTINOSUM (Fig. 15).

From a specimen of *Plethodon glutinosum* twenty mm. in length and showing the chondrocranium in an advanced stage of development, I have modelled the nasal capsules. In regard to the rest of the skull mention of a few points will suffice.

In the main it corresponds closely with the skull of Amblystoma as described in our fifth stage (Figs. 12 and 13). This similarity is especially noticeable in the position of the pterygoid process. There is a stapes, the antero-dorsal point of which, unlike that of Amblystoma, is connected to the quadrate by a very slender stapedial process. The otic and palato-basal processes present the usual conditions.

Aside from the rod connecting the dorsal and ventral

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processes in front of the narial duct all the parts described for the nasal capsule of Amblystoma are found in approximately the same positions in Plethodon with unimportant modifications as to relative sizes. This similarity is even more apparent in older specimens of Plethodon than in the one from which this model was made. The two small foramina in the lamina cribrosa mark the points at which a branch of the ophthalmicus profundus (*rp*) enters and leaves the capsule.

NECTURUS MACULATUS.

Cope ('89) has placed *Necturus maculatus* with its American relative *Necturus punctata* and the European Proteus in a group together under the name Proteida with the remark that they occupy a position intermediate between the Stegocephali and the Urodela, and differ from the latter mainly in the possession of an intercalary bone. Descriptions of three stages in the development of the chondrocranium of *Necturus maculatus* are here given.

FIRST STAGE. — The first stage represents the skull of an embryo twenty-one mm. in length, and corresponds approximately to the condition found in Amblystoma at a time a little earlier than that represented in the third stage of the latter (Figs. 4-7). The occipital arch consists of two processes extending upward from the sides of the notochord and ending freely above. At their bases they are connected with the posterior ends of the parachordals.

The parachordals run forward from the bases of the occipital processes, slightly removed from the sides of the notochord. Between the posterior ends of the otic capsules they bend inwards and touch the sides of the notochord to which they are attached for a short distance, then curve sharply outward, and, fusing laterally with the capsular floors, continue forward into the trabeculæ. The notochord projects forward some distance in front of the most anterior point at which the parachordals touch its sides. The otic capsules are widely separated and incompletely formed. Their floors are partially attached to the parachordals and the only traces of the median wall are found around the inner margins of its walls. A large fenestra ovalis, with no stapes, and a large foramen for the exit of branches of the seventh nerve constitute the only well defined apertures which are found in later stages.

The trabeculæ extend forwards from the anterior ends of the parachordals as long slender rods running parallel for the posterior three-fourths of their length and then bending inward at an angle of about thirty degrees towards the median line, which they do not reach. There are, as yet, no foramina for the second and third nerves and only a slight trace of a trabecular crest to which the ascending process of the quadrate is attached.

The quadrate is wedge-shaped as seen either from the side or in front, the point being directed ventrally. A short otic process extends upward and backward from the dorso-lateral angle of the wedge and fuses with the otic capsule, while a longer ascending process extends upward and forward from the dorso-median angle and fuses with the dorsal end of the slightly developed trabecular crest.

SECOND STAGE. — Our second model is that of an embryo twenty-four mm. in length. The occipital processes are fused distally with the walls of the otic capsules and continue along the dorso-median angles of the capsules as the beginnings of the synotic tectum. The jugular foramen is at this stage a dorso-ventrally elongated slit.

In place of the distinctly outlined parachordals of the previous stage we now have a continuous basilar plate lying beneath that portion of the cranial cavity included between the posterior halves of the otic capsules. As before, the notochord projects freely forward in the median line. Laterally and in front the basilar plate merges into the capsular floors and the trabeculæ.

The otic capsules present essentially the same conditions found in stage three of Amblystoma (Figs. 4–7) except that the otic process of the quadrate is fused with the antero-ventral surface of the capsule. A trabecular crest just large enough to enclose the optic and oculomotor foramina and to form a point of attachment for the ascending process is now developed. The appearance of simple antorbital processes upon the sides of the trabeculæ is the only further change which needs mention here.

THIRD STAGE.—*Larva forty-five mm. long* (Fig. 16). A continued fusion of the margin of the occipital process with the wall of the otic capsule, resulting in a reduction of the size of the jugular foramen is the most noticeable change in this region. The synotic tectum is now fully developed and presents the usual form. The basilar plate remains the same as in the previous stage.

The otic capsules have reached their highest state of development. The median wall is perforated by four foramina which correspond almost exactly to those described for the otic capsule of the fourth stage of Amblystoma (Fig. 11). In fact the only differences of any importance between the otic regions of this skull and that described as the fourth stage for Amblystoma are in the absence of the parachordals at the anterior end of the notochord, and the more median position of the foramen for the palatine nerve (*pal*). A small crest is now developed along the posterior half of the trabecula. A slender connecting rod unites the posterior end of the crest with the opposite wall of the otic capsule. Antorbital processes project outward and forward from the sides of the trabeculæ.

By a fusion of the anterior ends of the trabeculæ in the median lines a small ethmoid plate is formed, upon the anterior end of which is a slight prominence, the only indication we have of a nasal septum. Upon each side a short forward-projecting process terminates the ethmoid plate anteriorly.

Entirely separated from the rest of the cartilaginous parts of the head there is now a delicate nasal capsule (Fig. 16, *nc*). It consists of a curved rod, which runs along the dorso-median surface of the olfactory organ, following more or less closely the direction of the anterior end of the trabecula and the ethmoid plate, and a number of shorter processes projecting laterally from this main rod over the top of the olfactory organ. As Pinkus ('94) has pointed out, there is some resemblance between this nasal capsule and that of Protopterus, but it seems to me hardly necessary, for reasons which will appear more fully later, to attach any importance to this similarity other than that of a coincidence.

One would seem justified in expecting that, if Necturus occupy a position intermediate between the Stegocephali and the Urodela, the chondrocranium of Necturus would show more or greater differences from the typical Urodele chondrocranium than are found in higher Urodeles, the Urodela of Cope. But I am unable to discover that this is the case. It would be difficult, rather, to point out a form in which the chondrocranium is more typically Urodelan.

AMPHIUMA MEANS.

The first of the two models of the chondrocranium of *Amphiuma means* here described is the one which formed the basis of the description of the chondrocranium in Dr. Kingsley's preliminary paper upon "The Head of an Embryo Amphiuma" ('92). The chondrocranium of another specimen from the same lot of embryos was also described and figured by Professor O. P. Hay in his paper of '90.

FIRST STAGE.—(Figs. 17–18).—The occipital processes have fused with the otic capsules and their distal ends project inward over the sides of the cranial cavity as the first steps in the formation of the synotic tectum. The parachordals (Fig. 18, *p*) extend forward from the bases of the occipital processes, and, after curving inward to the sides of the notochord and fusing beneath it, they each divide into a median and a lateral band. The lateral bands of the two sides curve outward and, fusing with the capsular floors, pass forward to the posterior ends of the trabeculæ. The median bands separate in front of the apex of the notochord, bend laterally and join the lateral bands again at their junction with the trabeculæ. Between these two parts of each parachordal a fontanelle is enclosed.

The otic capsules present nearly the same condition as that found in the fourth stage of the skull of Amblystoma. But here, as was also noted in Necturus, the foramen for the palatine branch of the seventh nerve (*pal*) is on the median side of the median capsular wall.

The trabeculæ extend from their union with the parachordals forward to the nasal region, where they fuse in a small ethmoid plate which is terminated anteriorly by two broad triangular cornua. Along the middle and posterior end of each trabecula is a well-developed crest covering in the optic and oculomotor foramina as usual. It is connected postero-dorsally with the anterior end of the otic capsule, and it is also connected with the median angle of the quadrate by means of the ascending process (*ap*). The point at which the ascending process joins the trabecula is relatively farther anterior in Amphiuma than in Amblystoma, thus producing more elongate foramina for the exit of the nerves coming from the Gasserian ganglion (Fig. 18, *v*). Antero-dorsally the crest gives rise to a rod of irregular shape, which projects forward, outward and downward. This is the lamina cribrosa (*e*). Below and a little behind this the antorbital process is just beginning to appear upon the side of the trabecula.

The quadrate is rhomboidal in outline when viewed from the side. It is connected with the trabecular crest by the ascending process, as mentioned above, but as yet it has not fused with the otic capsule. From its posterior angle a slender stapedial process (Fig. 17, *sp*) extends backward into the anterior end of the fenestra ovalis where it joins the small stapes. No pterygoid process is yet developed. Meckel's cartilage articulates with the antero-ventral surface of the quadrate.

SECOND STAGE.—(Fig. 19).—In the second stage of the chondrocranium of Amphiuma, ossification is far advanced. The most important additions to the cartilages are seen in the completed nasal capsule and the pterygoid process (*pt*) of the quadrate which is now developed.

The distal ends of the occipital processes have developed into a narrow synotic tectum, while the notochord and median portions of the parachordals have disappeared except in the occipital region, where they form a ventral band (*p*) connecting the two capsules. No changes worthy of notice have taken place in the otic capsules aside from the results of ossification.

The trabeculæ are divided into anterior and posterior portions by ossification in the orbital region. The posterior portion remains essentially the same as in the first stage, but the anterior portion is changed by the formation of the nasal capsule. The base of the antorbital process (Fig. 19, *anp*) marks the posterior end of that portion of the trabecula remaining unossified in front of the optic foramen. A narrow column of the trabecular crest projects upwards from just in front of the base of the antorbital process, and upon the anterior end of the ethmoid plate a thin nasal septum is developed. Two cartilages upon each side arise from the dorsal end of the septum. From its posterior end a cylindrical rod, the tectal cartilage (*te*) extends backward and outward to the dorsal point of the remnant of the trabecular crest. From the posterior end of the septum a band of cartilage extends forward and expands into a broad sheet, the nasal tectum, roofing over the whole anterior portion of the olfactory organ. Where the nasal duct passes out to the exterior (*nl*) at the anterior end of the tectum, a complete ring of cartilage encircles it. Laterally the nasal roof is connected by a band curved ventrally with the cornu (*c*) of the trabecula. And from the postero-lateral margin of the tectum a flattened rod (*l*) passes backward to the tectal cartilage, fusing with it at a point just above the anterior end of the antorbital process.

While it is impossible to homologize all the parts of the nasal capsule of Amphiuma with those in Amblystoma there are some points in which the similarity between them is very close. The septa, ethmoid plates, and tectal cartilages are essentially alike in both. The lamina cribrosa and dorsal process of Amblystoma are represented in Amphiuma by the rod connecting the tectal cartilage with the nasal tectum. The open anterior end of the capsule of Amphiuma is quite different from the cup-like end of Amblystoma to which it must be compared. This difference in the capsules is, of course, correlated with the relative change of position of the nostrils, which are at the anterior end of the capsules in Amphiuma and in the middle of the sides of the capsules in Amblystoma. In Amphiuma the antorbital process does not become fused with the lamina cribrosa.

The quadrate is now supplied with a pterygoid process (*pt*) which runs forward from the ventral surface of the ascending process in close proximity with the ventral margin of the trabecula. Towards its anterior end it curves laterally and broadens out into an oval plate. Its anterior end lies a short distance postero-laterally from the base of the antorbital process. Otic and palato-basal processes unite the quadrate with the otic capsule. The stapes has expanded into a broad plate nearly filling the fenestra ovalis. It is still connected with the quadrate by a strong stapedial process (*sp*).

CHARACTERISTICS OF THE URODELE CHONDROCRANIUM.

From the preceding descriptions of the chondrocrania of various Urodeles, we may briefly enumerate the more important characteristics of the cartilaginous skull as found in this group.

Two occipital processes, the early history and relationships of which have been more fully treated by Ph. Stöhr ('79), arise independently at the sides of the notochord in front of the first permanent vertebra. The similarity between these processes and those of which the vertebræ are formed clearly indicates the vertebral nature and origin of the occipital arch. From the sides of the notochord the occipital processes pass upward, fuse with the walls of the otic capsules and bend over medially to form the synotic tectum (Fig. 18, *ocp*). Two large jugular foramina are enclosed between the bases of the occipital processes and the posterior ends of the otic capsules. Parachordals, varying in size and extent from the narrow bands of Desmognathus (Fig. 14, *p*) to the complete basilar plate of Amblystoma (Figs. 9 and 10 *p*), form a more or less complete floor beneath the otic portion of the brain cavity. The otic capsules are approximately oval in shape and in all cases have a median wall distinctly separating the cavity of the capsule from that of the brain. There are generally four foramina in this wall through which pass the seventh and eighth nerves and the endolymphatic and perilymphatic ducts. In the ventro-lateral wall of the capsule there is a large fenestra ovalis which may or may not be occupied by a stapes. When present the stapes appears first at the anterior end of the fenestra and only later, if at all, does it reach back to the posterior wall of this aperture. The stapes may be connected with the quadrate by a stapedial process.

Trabeculæ, either slender rods with barely enough crest to cover in the optic and oculomotor foramina as in Desmognathus, or solid beams as in Amblystoma, connect the parachordals and otic capsules with the nasal capsules. At its posterior end there are two places at which each trabecula joins the cartilages of the otic region. Of these points of fusion, the ventral, joining the base of the trabecula with the parachordal, is formed early, while the dorsal, joining the trabecular crest with the otic capsule, is a later occurrence. Anteriorly the trabeculæ usually bend inward, and, fusing in the median line into an ethmoid plate, take part in the formation of somewhat complex nasal capsules. But here, again, Desmognathus, with nothing more complex than cornua trabeculæ (Fig. 14, *c*), proves an exception to the general rule.

An antorbital process projects outward and forward from the side of the ventral margin of the trabecula behind the olfactory organ. In some forms it later fuses with the other parts of the nasal capsule. The variety of forms shown by the nasal capsules of the different species described renders it difficult to make any accurate statements in regard to these organs which shall apply to the group as a whole. More extended study may show the prevalence of a limited number of these types as is suggested by the similarity between Amblystoma and Plethodon.

Quadrates, arising independently near the anterior end of the otic capsules, later become attached to the rest of the skull by three or four processes. The ascending process unites it with the trabecular crest; the palato-basal with the parachordal; the otic with the otic capsule; and the stapedial process, when present, unites it with the stapes. The palato-basal and otic processes become so intimately related that the blood vessel running between them is the only line of demarcation. A pterygoid process running forward from the body of the quadrate may or may not be present. When present it ends freely in front, not coming in contact with the anterior end of the trabecula and nasal capsule as occurs regularly in the Anura. Ranodon forms the only known exception among the Urodeles to this last statement.

PIPA AMERICANA (Figs. 20–21).

In the single stage of the chondrocranium of Pipa which I have modelled, ossification has proceeded so far that many of the cartilages appear only as remnants of what they were earlier. A brief outline of this skull, however, may serve as a basis from which, with the aid of other studies upon the Anura, especially Gaupp's exhaustive work upon *Rana fusca*, we may contrast the chondrocranium of this group with that of the Urodela.

The occipital processes have fused with the otic capsules and their distal ends have developed into the synotic tectum. The parachordals are reduced to a narrow transverse band immediately in front of the base of the occipital arch, and short lateral bands fused with the floors of the otic capsules. The greater part of the wall of the otic capsule is ossified, but enough of the lateral wall remains to show the most important relationships. In this lateral wall of the capsule, further dorsally than in the Urodele skull described, is the fenestra ovalis and in it a small stapes (Fig. 20, *s*) which is connected by a rod running forward and downward with the lateral border of the tympanic annulus (*ta*).

The trabeculæ are small, cylindrical rods extending forward from the ventro-median angles of the anterior ends of the otic capsules and fusing in the broadly expanded ethmoid plate. In the median line the ethmoid plate is continued forward into the nasal septum. At the sides of the posterior end of the septum the ethmoid plate is perforated by the olfactory foramina (*ol*). A triangular lamina cribrosa (*l*) projects outward, downward and forward from each antero-lateral margin of the ethmoid plate. This and the septum with the connecting rods compose the nasal capsules.

From the ventro-lateral margin of the lamina cribrosa (Fig. 21) a slender cartilage projects horizontally inward to beneath the inner border of the lamina where it splits into two cylindrical rods, a dorsal and a ventral. The dorsal rod (*d*) extends forward inward and upward to the antero-dorsal point of the septum, while the ventral rod (*vp*) curves sharply inward, touches the ventral margin of the septum and then, slightly expanding in width, terminates in a process projecting freely forward. A small foramen for the orbito-nasalis, seen only when the skull is viewed from below (*on*), passes beneath the posterior end of the lamina-cribrosa just outside the anterior end of the trabecula. The short so-called 'palatine cartilage' is, as has been shown by Gaupp, the homologue of the antorbital process of the Urodela.

The quadrate is situated much nearer the posterior end of the skull than that of the Urodela described. It lies about under the middle of the lateral wall of the otic capsule, to which it is connected by means of a dorsal otic and a ventral palato-basal process. There is no stapedial process connecting the quadrate directly with the stapes, but, as was mentioned above, the stapes is connected with the tympanic annulus which is earlier derived from the quadrate. A slender palato-pterygoid process (*ppt*) projects forward from the body of the quadrate and fuses with the lateral margin of the lamina cribrosa. The relatively posterior position of the quadrate adds proportionately to the length of Meckel's cartilage.

ANURA AND URODELA CONTRASTED.

From a general view of the chondrocrania of these two groups it is seen that, on the whole, in the Anura the width is greater in proportion to its length than in the Urodela. But since there are many very short and broad skulls among the Urodela this distinction is of little value. The closure of the cranial cavity is more complete in the Anura, especially in the ventral region where the basicranial fontanelle, as shown by Gaupp ('93), becomes greatly reduced. Here, too, instead of ending freely, the pterygoid process of the quadrate is attached anteriorly to the ethmoid plate. In these two last mentioned points the Anura show more resemblance to the Selachians than do the Urodela.

We may here insert a few words in regard to the homologies and terminology of the cartilages which have been variously called the 'antorbital process' and the 'palatine cartilage.' Gaupp ('91) maintained the homology of the 'antorbital' of the Urodela with the palatine of the Anura. Speaking of this cartilage in Amphiuma, Kingsley ('92) said, "the lower process may retain the name, antorbital, usually applied to it, for Amphiuma presents no evidence that it is the palatine cartilage as Gaupp interprets it." In his final paper on the chondrocranium of Rana, Gaupp ('93) repeats his former position and, stating that he uses the two terms interchangeably, comments upon the above quotation as follows: "Kingsley scheint unter 'Palatine Cartilage' hier etwas Besonderes zu verstehen; was das ist, kann ich aus seinen Angaben nicht ersehen."

There seems to be no doubt as to the correctness of the homology of the cartilages as pointed out by Gaupp. The question here, however, is one of terminology and it is not to be settled by the fact that certain authors have called this cartilage the palatine, but upon the broader grounds of comparative anatomy, and here the question of priority must also be taken into account. The term palatine bone in some of its various modifications was first applied to a bone occurring in the palatal region of the Mammalia, and, in transferring the name to other classes of vertebrates, it is obligatory that it should be given only to those structures which are homologous with the palatine of mammals. That the palatine *bone* of the Amphibia is homologous with the palatine bone in the mammals I do not deny, but I maintain that this cartilaginous process is in no way a palatine process but that rather its relations are with the nasal capsule, and for the following reasons:

In the mammals the palatine bone is regularly enumerated among the membrane bones (Minot '92, *inter alia*) and, so far as I am aware, it has no connection with any cartilage. To attempt to homologize a membrane bone with a cartilage is a difficult task. If, however, it be maintained that we have here a case of substitution such as exists in the roofing bones (parietals, frontals, etc.) of the cranium, in which the cartilaginous roof of the brain cavity becomes replaced by the immigration ot dermal bones, Ichthyophis throws considerable light upon the question. In this form the palatine bone (part of the maxillopalatine process of the Sarasins), which is distinct in early stages, arises, not in connection with the cartilaginous process in question, but with the nodule of cartilage shown in Figs. 22, 23, and 24, *pc*. In Ichthyophis not only is this true cartilaginous 'palatine' present but the antorbital process occurs as well.

If we adopt the usually accepted homologies (which, however, are not beyond question) the palatine of the higher vertebrates is to be sought in the anterior portion of the upper jaw of the Elasmobranchs, which is accordingly called the palato-pterygo-quadrate or some similar term, implying homologies with the palatine of higher forms. In these very Elasmobranchs, however, the exact homologue of this antorbital process exists, in no way connected with the upper jaw but rather as forming a part of the nasal capsule.

The transformation during metamorphosis from a condition in which the jaw of a small suctorial mouth articulates with the anterior end of the pterygoid cartilage to one in which it reaches back to the body of the quadrate beneath the middle of the otic capsule is one of the most striking characteristics of the Anuran chondrocranium. Another of its distinctive features is found in the auditory apparatus. While in the Urodela the fenestra ovalis may be occupied by a cartilaginous stapes which may or may not be connected with the quadrate by a stapedial process, in the Anura we find a much more complicated condition. The fenestra ovalis passes through important changes of form and the stapes comes into connection with a tympanic annulus. But if the tympanic annulus was "originally a postero-superior leaf cut off from the mandibular suspensorium," as stated by Parker and Bettany ('77), the fundamental similarity of the conditions in the two groups is apparent. In connection with this point Gaupp says, "Der vom Quadratum losgelöste knorpelige Annulus tympanicus scheint eine dem Anuren allein zukommende Bildung zu sein." Here, as with the Urodela, the nasal capsule offers little that is of classificatory value.

The chief points of difference between the chondrocranium in the two groups may be tabulated as follows:

URODELA.	ANURA.
1. Both broad and narrow types.	1. Generally, if not always, broad.
2. Pterygoid free in front (except in Ranodon).	2. Pterygoid attached to ethmoid plate.
3. Basi- and supra-cranial fontanelles large.	3. Basi- and supra-cranial fontanelles smaller.
4. No metamorphosis.	4. Very striking metamorphosis.
5. Auditory apparatus comparatively simple.	5. Auditory apparatus, including the tympanic annulus, complex.

ICHTHYOPHIS GLUTINOSUS.

FIRST STAGE.— (Figs. 22 and 23).—The specimen from which the model for this stage was made was a young embryo still spirally coiled within its membranes. While in some places, more particularly toward the anterior end of the head, the tissue modelled is not true cartilage, the differentiation of all the parts is sufficient to cause little difficulty in distinguishing them.

The notochord occupies its usual position at the posterior end of the cranium; but, as it passes forward, it bends downward so that its anterior end lies considerably below the general level of the cranial floor. The parachordals are represented only by a narrow band of cartilage connecting the posterior ends of the otic capsules. In the median line the notochord is embedded in this band. At its lateral margin the parachordal band fuses with the occipital process behind and with the otic capsule in front. The dorsal end of the occipital process is fused with the otic capsule. Between these three cartilages is the jugular foramen (*j*).

The otic capsules are longer, narrower and deeper than those of Amblystoma, and, as is usual in the younger stages, they are comparatively widely separated. In the median wall of each capsule are two foramina, a larger anterior and a smaller posterior foramen. The ventrolateral wall of the capsule is largely taken up by the fenestra ovalis along the dorsal part of which lies the stapes. The stapes is continued forward into a process which reaches the posterior surface of the quadrate. This process may retain the name 'stapedial process,' although in this case it is continuous with the stapes rather than with the quadrate. The stapes is perforated in a dorso-ventral direction for the arteria perforans stapedia (Fig. 23, *as*).

Three processes arise from the anterior end of the otic capsule. Two of these, which I shall call the dorsal (*dr*) and ventral (*vr*) trabecular rods, extend forward in the usual positions of the dorsal and ventral margins of the trabecula. The third, and relatively much shorter process is attached posteriorly to the otic capsule just below the end of the dorsal trabecular rod. Curving downward and forward it fuses with the ventral trabecular rod. In the posterior end of the ventral trabecular rod there is a small foramen traversed by a nerve (apparently the palatine). This foramen does not appear in the later stages modelled but I am unable to give the details of the disappearance.

After passing forward separately to the orbital region, the dorsal and ventral trabecular rods of each side are connected by two narrow bands of cartilage, a post-orbital (*pob*) and a pre-orbital (*prb*) between which the elongated optic foramen (*of*) is enclosed. Beginning in the region of the post-orbital band the dorsal and ventral trabecular rods of each side, which have thus far been approximately parallel, diverge in a horizontal direction. The dorsal rod curves first outward and then inward, giving off ventrally a plate-like lamina cribrosa near its anterior end. The two ventral rods bend inward to the median line where they unite to form a small ethmoid plate. Just behind their point of fusion each ventral rod gives off a ventro-lateral process which underlies the posterior end of the olfactory vesicle. From the anterior margin of the pre-orbital band of cartilage an antorbital process (Fig. 23, *anp*) extends outward and forward towards the ventral portion of the lamina cribrosa.

The quadrate is composed of a body, and ascending and pterygoid processes. The body is small and stands out from the side of the ventral trabecular rod below the anterior end of the ear capsule, with which it is not directly connected. The ascending process passes upward and forward and unites with the dorsal trabecular rod a little in front of the ear capsule. The pterygoid process (*pt*) is composed of two parts, a short proximal portion which projects forward from the body, and an isolated portion which later becomes the distal end of the process. This method of development of the pterygoid is the same as that mentioned by Gaupp ('91) for Siredon. A short distance in front of the distal portion of the pterygoid is another isolated rod of cartilage which runs in a direction diagonal to that of the pterygoid process. This is the palatine cartilage (*pc*).

Meckel's cartilage articulates with the ventral surface of the body of the quadrate. Anteriorly the cartilages of the two sides are still separated. They project backward behind the point of articulation with the quadrate nearly as far as the posterior end of the stapes (*a*).

SECOND STAGE. — (Figs. 24–26). — The parachordals and occipital processes are in the same condition as before, there being no trace of the formation of a synotic tectum. The notochord has entirely disappeared from the head region. The median wall of the otic capsule is more complete than it was in the first stage (Fig. 25). What was then the large anterior foramen is now divided into a dorsal foramen for the endolymphatic duct (*ef*) and a large ventral foramen for the auditory and facial nerves. The floor of the capsule is now composed of a median and a more lateral rod between which a fontanelle is enclosed. The stapes and fenestra ovalis are in the same condition as in the preceding stage.

The rod described in the first stage as connecting the anterior end of the otic capsule with the ventral trabecular rod now has a nearly vertical direction, the ventral end being relatively more posterior in position than before. As far forward as the orbital region there are no other noteworthy changes. In the nasal region, however, important changes have occurred. Instead of the transversely expanded nasal region of the earlier stage, we now find the anterior ends of the dorsal trabecular rods folded inward toward the nasal septum and forming a roof over the sides of the olfactory organs. By this movement the lamina cribrosa is brought into its usual position. Its distal end is fused with that of the antorbital process thus enclosing the orbito-nasal foramen (Figs. 24 and 26, *on*).

The ethmoid plate is larger in both directions than in the first stage, and in the median line upon its anterior half arises the nasal septum (*ns*). In front, upon the sides of the base of the septum, the ethmoid plate terminates in short free processes. The nasal septum is divided anteriorly into three parts, a short median process which projects freely forward, and two lateral bands which curve forward and outward. At its most anterior point each of these bands divides into a dorsal and a ventral process. These extend backward along the lateral surface of the olfactory organ and fuse with the outer end of the cartilage mentioned in the first stage as arising from near the anterior end of the ventral trabecular rod. Where these three processes meet a plate of cartilage is formed which lies below the lamina cribrosa and is connected with it by a short narrow band. No tectal cartilage is formed in the chondrocranium of Ichthyophis.

As a result of ossification the ascending process of the quadrate has lost its cartilaginous connection with the dorsal trabecular rod (Fig. 24), and the parts of the pterygoid process are now united into one continuous rod. The body of the quadrate remains essentially unchanged, it having neither otic nor palato-basal process. The two cartilages of Meckel are now confluent in front, and the palatine cartilage still remains isolated from the rest of the chondrocranium. It appears that the ancestors of the Batrachia had a palato-pterygo-quadrate cartilage similar to that found in sharks. Of these cartilages the Urodeles as a rule retain only the pterygoid and quadrate portions. The Cæcilians have these two parts and an isolated palatine portion, while in the Anura all three parts are united in one rod which is joined in front to the antorbital process.

THE CÆCILIAN CHONDROCRANIUM.

There are two views according to which the Cæcilians are related to Amphiuma. According to one — the theory of Cope ('89[a]) — the Cæcilians are the extreme of a line of degeneration from the typical Urodele stock and Amphiuma is one of the intermediates of the series nearest to the Gymnophiona. Indeed, Cope goes so far as to make the Cæcilians merely a family of the Urodeles. The other view is that of the cousins Sarasin who hold that Amphiuma is a neotenic Cæcilian, a larval Cæcilian become sexually mature while retaining their branchial respiration.

According to the first view Amphiuma, and to a less extent the rest of the Urodeles, must be closely similar in cranial as well as other structures to the young Cæcilian. Farther, if we find that Amphiuma and the Urodeles have lost certain features which belonged to the ancestral Craniota, the retention of these characters by the Cæcilians would be an argument against the line of descent advocated. The view of the Sarasins presents even more difficulties for we have both horns of the dilemma. If Amphiuma be merely a Cæcilian arrested in a larval condition, then we have to say either that Amphiuma is not related to the remaining Urodeles or that they have all sprung from a Cæcilian ancestry. The objections to the second view are so many and so weighty that we think no one would care to defend it. The limbs alone are enough to set it aside. As to the other horn, it would seem that all the evidence we have regarding adult structure and development as well goes to show that Amphiuma is far more closely allied to the other Urodeles than it is to the Cæcilians, while the same matter of limbs, weak though they be in Amphiuma, throws the whole view out of court.

There remains then but the view of Cope, and this is to be tested by seeing if there be features in the Cæcilians which must have been inherited and which could not have been inherited from an Urodele ancestor.

The parachordals of Ichthyophis are smaller than those of any other form studied. The nearest approach to them is found in Desmognathus where there are bands, not present in Ichthyophis, connecting the anterior end of the notochord with the otic capsules. No synotic tectum is formed in Ichthyophis, though at one period in the development of the skull small crests on the dorso-median walls of the otic capsules represent the first steps in the formation of a tectum. This appearance, however, is slight and but transitory.

There is a difference between the manner of development of the trabeculæ of Ichthyophis and those of the other Batrachia described. Instead of being developed by the successive formations of a ventral rod, a trabecular crest and a connective rod uniting the crest to the otic capsule, we have the dorsal rod developing simultaneously with the ventral rod and equally well chondrified. The dorsal rod, separated as it is from the ventral rod and attached to the anterior point of the otic capsule, somewhat resembles the supraorbital band of fishes. But the fusion of the ascending process of the quadrate with the dorsal rod and the relations of the two trabecular rods anteriorly are clearly Urodelan characters. The quadrate is peculiar, however, in having no otic or palato-basal processes. Aside from the ascending process and stapes it is entirely separated from the rest of the skull. Its position is the same as that of the Urodeles. The stapes is perforated for the stapedial artery.

But more important than any of the features mentioned above is the existence of an isolated palatine cartilage. This is especially noteworthy since it seems to furnish strong evidence in opposition to the theory of the Urodelan ancestry of the Cæcilians. Ranodon is the only Urodele which possesses that portion of the palato-pterygoid arch which may be considered to correspond to the palatine cartilage of Ichthyophis, while in Amphiuma there is not the slightest trace of it. We may therefore conclude that the condition found in Ichthyophis was not derived from an Urodelan ancestor but from some more primitive form.

The articular process of Meckel's cartilage is unusually long in Ichthyophis. The nasal capsules, while differing from all the others described, have no features of sufficient importance to be of any especial classificatory value.

The evidence which I have found, chiefly from a study of the chondrocranium, appears to me to be against associating the Cæcilians with any of the Urodeles and in favor of keeping them in a distinct group coördinate with the Urodela and Anura.

POLYPTERUS BICHIR (Fig. 27).

In 1892 the late H. B. Pollard kindly allowed Dr. Kingsley to trace the outlines of the cartilages in the sections of the head of his youngest Polypterus. From these drawings I have made the chondrocranium in wax. Since the skull of this same specimen has already been described and figured by Pollard ('91) I shall deal chiefly with points of value from a comparative standpoint. For further details in regard to the relations of the chondrocranium to the rest of the head, reference should be made to Pollard's paper which contains a dorsal view of the skull and drawings of sections through various parts of the head.

No cartilaginous occipital arch is present, owing, apparently, to ossification. The otic capsule is large and selachian-like in form. In its postero-lateral wall there is a large aperture exposing portions of the posterior and horizontal canals. This also is probably due to ossification. A small remnant of the hyomandibular cartilage (*h*) lies in a groove in the dorso-lateral surface of the capsule. That it formerly reached down as far as the posterior end of the pterygo-quadrate cartilage is shown by the figures of Pollard and others.

A thick synotic tectum covers the brain cavity in the posterior two-thirds of the otic region. There are indications of a medial capsular wall separating the brain cavity from the cavity of the capsule at its posterior and anterior ends, but the greater part of the space is entirely open. The floors of the capsules are continuous with the basilar plate which slightly exceeds the synotic tectum in extent. A peculiar rod of cartilage (*bo*) projects a short distance backward from beneath the middle of the basilar plate. At the anterior end of the capsules there are upon each side two foramina and a deep groove which is now open in front and apparently represents another foramen the anterior wall of which is ossified. A short bar of cartilage passes across the external opening of the posterior of the two foramina, dividing it here into two. The unossified posterior end of the supraorbital band remains as a solid lateral projection upon the anterior end of the otic capsule.

There is a complete separation of the chondrocranial elements of the otic region from those of the orbital and nasal regions. The supraorbital band (*sb*) passes anteriorly into a broad tegmen cranii (*tc*) which covers over the anterior end of the cranial cavity and continues forward into the roof of the nasal capsules. Ventrally a solid plate of cartilage (*t*), the trabecular plate, forms a continuous floor beneath the anterior end of the cranial cavity and the nasal capsules, and projects forwards as a short and rather blunt rostrum (*r*). A small isolated plate of cartilage (*tc*) occupies the middle of the supracranial fontanelle, a remnant, as Pollard suggests, of a primitively complete tegmen cranii.

The nasal capsule consists of a large cavity enclosed by simple, broad plates of cartilage. Its floor and roof are connected by a tall septum medially and two bands laterally. The posterior of these two bands marks the boundary between nasal capsule and cranial cavity. There are three large apertures in the capsule walls: behind, the olfactory foramen; in front, the foramen for the nasal duct (*nl*); and between them a third in the lateral wall. Besides these there are two small foramina in the border of the nasal roof, the 'canalis ethmoidalis' (*ec*) and the 'canalis preorbitalis' (*prc*). Dorsally these two are connected by a deep groove.

The anterior end of the palato-pterygo-quadrate cartilage (*ppt*) is applied to the ventro-lateral surface of the nasal capsule. From here it passes backward as a broadening band to a point beneath the outer wall of the otic capsule and the hyomandibular cartilage. In passing from in front backward it twists from an approximately horizontal to a nearly vertical plane.

THE TROUT (*Salmo fontinalis*), (Figs. 28–29).

For a representative of the Teleostean skull I have modelled the chondrocranium of a trout embryo twenty-two mm. in length. The occipital arch is fused with the otic capsules leaving no suggestion of their former separation, except in the jugular foramina (Fig. 29 *j*). The notochord extends forward beyond the middle of the otic region. Its sides are embraced by the two halves of the basilar plate. At its apex it projects freely forward for a short distance. Except for a small fontanelle (*f*), the basilar plate is continuous with the walls of the otic capsules which are united above by a broad, arched synotic tectum. The positions of the semicircular canals are clearly indicated in the external surface of the otic capsules. No median wall separates the cavity of the ear from that of the brain. In front and a little below the jugular foramen there is another smaller foramen through which the ninth nerve (*ix*) passes out of the cranium. Farther forward there are three more apertures in the ventral wall of the capsule. The posterior of these is the fontanelle mentioned above. The middle one of the three is small and is traversed by the hyomandibular branch of the facial nerve (*hy*). The anterior foramen is for the exit of a branch of the jugular vein (*jv*).

The basilar plate is continued forward into a trabecula upon either side. These extend separately to a point in front of the hypophysis and then unite along the median line in a narrow trabecular band. This band has the shape of an inverted trough and reaches to the anterior end of the skull, expanding in the nasal region into the ethmoid plate which forms the floor of the nasal capsules. The palatine branch of the seventh nerve (Fig. 28, *pal*) passes downward through a foramen in the posterior end of the trabecula. Two slender supraorbital bands (*sb*) arise from the anterior ends of the otic capsules and curve forward and inward, until about half way from the otic to the nasal region, where they enter the margins of the arched tegmen cranii which covers the anterior end of the cranial cavity. This cranial roof is fused anteriorly with the dorsal end of the nasal septum (Fig. 28, *ns.*) In its anterior end there are three apertures, a median fontanelle and two small lateral foramina, through each of which passes a branch of the ophthalmicus superficialis (*rs*). A band of cartilage connecting the tegmen cranii and the dorsal end of the septum with the lateral border of the ethmoid plate separates the nasal region from the cranial cavity. There is no cartilaginous roof or lateral wall to the nasal capsule. The septum is thick and slightly expanded dorsally and in front where it ends bluntly.

The anterior end of the pterygo-quadrate cartilage is applied to the ventro-lateral margin of the ethmoid plate. From here it extends backward as a slender rod to beneath the anterior end of the otic capsule where it broadens into an irregular plate with an articular process ventrally for the attachment of Meckel's cartilage. Its posterior end is connected with the otic capsule by means of the plate-like hyomandibular cartilage (*h*). The dorsal margin of this cartilage, the hyomandibular, lies closely pressed against the external surface of the otic capsule just beneath the horizontal canal. It is broad and thin above and narrower and thicker below. From its ventral end a long rod-like process runs forward beneath the posterior end of the pterygo-quadrate, reaching almost to the point of articulation with Meckel's cartilage. The hyomandibular branch of the seventh nerve passes through a foramen just above the middle of this cartilage (*hy*).

THE CHONDROCRANIUM IN THE FISHES.

The chondrocrania of the two types of this group which have been described have many features in common, and it seems probable that a comparison of corresponding stages in the development of the two forms would show a still more marked similarity. The otic capsules are connected dorsally by a solid synotic tectum and ventrally by an unbroken basilar plate formed by the fusion of the parachordals around the anterior end of the notochord. The median wall of the otic capsule is either absent or but slightly developed. Neither fenestra ovalis nor stapes occurs.

The trabeculæ unite ventrally into a median band in front of the hypophysis and continue forward to the end of the skull. At its anterior end the trabecular band broadens out into the ethmoid plate which forms the floor of the nasal capsules. Supraorbital bands extend forward from the anterior ends of the otic capsules to the lateral margins of the tegmen cranii which roofs over the anterior portion of the brain cavity.

The palato-pterygo-quadrate cartilage extends from the lateral margin of the ethmoid plate backward to beneath the anterior end of the otic capsule. Its posterior end is supported to a greater or less degree by the ventral end of the hyomandibular cartilage which has its dorsal end closely applied against the outer wall of the otic capsule. Meckel's cartilage articulates with the ventral surface of the quadrate portion of the palato-pterygo-quadrate cartilage.

In discussing the relations of Polypterus to the Batrachia, Pollard said, "On comparing the primordial cranium of a young Polypterus with that of Urodeles, the general resemblance is seen to be so great that an anatomist seeing it alone for the first time would certainly place it among the latter." Considering the features which distinguish the chondrocranium of Polypterus in common with the rest of the Fishes from that of the Batrachia, as outlined in the preceding pages, so great a similarity can hardly be admitted to exist. The great similarity pointed out above between the skulls of Polypterus and the trout and the many points in which they differ from the typical skull of the Batrachia cause me to feel considerable hesitancy about accepting the theory of the Crossopterygian ancestry of the Batrachia. But, while the presence in Polypterus of a large hyomandibular cartilage, a quadrate well removed from the otic capsule and a strong supraorbital band, as well as the absence of any fenestra ovalis or stapes, will remain important obstacles to this view until transitional stages are found, perhaps these difficulties are less than those attending the Dipnoan theory. Attention may also be called to the fact that in Polypterus there is a limited median capsular wall, which is not found in either the trout or Protopterus but which regularly occurs in the Batrachia.

PROTOPTERUS ANNECTENS (Figs. 30–32).

A model of the chondrocranium of Protopterus gives us a basis from which to compare the Dipnoi on the one hand with the Batrachia, to which they have been considered to be closely related, and on the other to the Teleosts and Ganoids.

Viewed as a whole the massive character of many of the cartilages of this skull is a most striking feature. Ossification in the occipital region somewhat obscures the relations between the skull and the first vertebra. The occipital processes are fused with the otic capsules leaving large jugular foramina in the usual position. The remnant of the notochord is imbedded in a solid parachordal plate extending from the posterior end of the skull forward to the middle of the otic region. On each side of the median line at the anterior end of the parachordal plate is an elongate fontanelle (Fig. 32,*f*). The walls of the otic capsules are continuous ventrally with the parachordal plate and dorsally with a strong synotic tectum. From the external margin of the otic capsule a broad ledge of cartilage projects horizontally outward, widening as it passes from behind forward where it terminates abruptly. There is no median capsular wall.

Band-like trabeculæ extend forward along the sides of the brain from the dorsal anterior end of the otic capsules to the optic region where they bend around ventrally to form a large ethmoid plate. From the dorsal margin of the anterior end of each trabecula a peculiarly bent antorbital process (*anp*) arises. It projects forward and outward, coming into close proximity to, but not fusing with the posterior end of the nasal capsule, and then it bends backward, running along the margin of the upper lip. The ethmoid plate narrows down in passing from behind forward, and terminates in two processes which bend sharply upward and fuse with the posterior end of the nasal septum. Between these two terminal processes there is an oval fontanelle.

The nasal capsule is a very peculiar one. The septum is a thin dorsal plate behind, but in front it becomes a solid cylindrical mass of cartilage projecting ventrally between the olfactory organs. The transition from one condition to the other is very abrupt. In front the septum ends in two short laterally directed processes. Six bands of cartilage extend outward and downward from the median septum to a curved marginal band (*mr*). Between these bands five apertures of various shapes and sizes are enclosed. The anterior of the six transverse bands projects somewhat beyond its point of fusion with the marginal band. As is seen in the ventral view (Fig. 32) a curved process extends inward and upward from the inner border of the marginal band. Its dorsal end is free. Just in front of the bend of the antorbital process is an isolated strip of cartilage occupying a diagonal position, one end being dorso-medial and the other ventro-lateral. A small cylindrical rod (*tc*) extends backward in the median line from the posterior end of the nasal septum and ends freely above the brain, a remnant of the ancestrally complete tegmen cranii.

The quadrate has its base firmly fused with the otic capsule and trabecula. It is a solid mass projecting downward and forward, and presents upon its anterior end a large articular surface for the enormous posterior end of Meckel's cartilage (Fig. 30). Except for a short distance in front of its point of articulation, Meckel's cartilage is of only ordinary size. There are upon each side of the lower jaw three labial cartilages (*lc*). As shown in the figure the posterior of these is separated from the jaw and divided into two parts, but this occurred upon the right side only. By mistake the anterior end of the lower jaw was drawn nearly straight instead of curved sharply upward as it should have been.

The ninth nerve (*ix*) passes out through a small foramen a short distance in front of the jugular foramen. Five foramina grouped about the anterior end of the otic capsule open upon the dorso-lateral surface of the skull. I have designated the nerves passing through these foramina in accordance with the work of Pinkus ('94). The third nerve passes through a small foramen (Fig. 30, *oc*) near the dorsal margin of the trabecula. Just below the foramen for the third is a larger one for the ramus ophthalmicus profundus of the fifth (*rp*), and still lower is another for the ramus maxillaris of the fifth (*rm*). A short distance behind this foramen are the openings of the other two lying close together, one above the other. The more dorsal of the two is traversed by two nerves, the ramus lateralis facialis of the seventh (*rl*) and the ramus ophthalmicus superficialis of the fifth (*rs*). The more ventral foramen is for a blood vessel (*b*).

Three foramina open upon the ventral surface of the skull in this same region (Fig. 32). Of these the anterior and smallest is for the ramus palatinus superior (*rps*). The other two openings are close together. The more median is for the main trunk of the seventh (*vii*) and the ramus palatinus inferior (*rpi*). The more lateral opening is the ventral end of the foramen for the blood vessel mentioned above.

THE CHONDROCRANIUM IN THE DIPNOI.

A comparison of the chondrocranium of Protopterus with those of the Batrachia and Fishes at once reveals its unique character. While resembling the typical chondrocranium of each of these groups in some respects, taken as a whole it is very different from either. The large otic capsule, with thick walls and separate foramen for the ninth nerve, and without a median wall or fenestra ovalis, greatly resembles the capsule of Fishes. But the suspensorial apparatus is entirely different from that of most Fishes and very similar to that of the Batrachia, that is to say, it is autostylic. According to Huxley ('76) this condition is also found in the Chimæroids and Marsipobranchii, but in none of the other Fishes. This is undoubtedly the strongest point of resemblance between the chondrocrania of the Dipnoi and Batrachia. And here the theory of the Dipnoan ancestry of the Batrachia is decidedly at an advantage over the Crossopterygian theory. But this similarity of the otic relations of the quadrate in these two forms is counterbalanced by differences in other respects. The absence of a palato-pterygoid cartilage is an especially noteworthy feature in this connection which indicates the highly specialized nature of this skull and renders it impossible to consider it a very near approach to the ancestral Batrachian skull.

The trabeculæ are unlike both those of the Fishes and those of the Batrachia. When their posterior ends are compared with the chondrocranium of the former group they seem rather to represent the supraorbital bands, arising as they do from the antero-dorsal surface of the otic capsules. But in passing forward, instead of curving up over the eye as supraorbital bands should do, they curve downward and fuse at their anterior ends into an ethmoid plate very much as occurs in the Batrachia. The antorbital process arises from the dorsal margin of the trabecula, a condition found in none of the other forms studied; and the ethmoid plate, instead of continuing forward to form a floor beneath the nasal capsules, as is the general method in both Fishes and Batrachia, curves sharply upward at its anterior end and fuses with the dorsally situated posterior end of the nasal septum. The possession of a remnant of the tegmen cranii is another fish-like character.

As was mentioned in the discussion of the chondrocranium of Necturus, there is some resemblance between the nasal capsules of that form and those of Protopterus. But, in view of the differences between the nasal capsules of the various forms of Urodeles themselves and considering the many important points of difference in other parts of the skull, it seems to me an entirely unwarrantable conclusion to assume any phyletic relationship between these two forms upon this account.

Günther has described the skull of Ceratodus as consisting "of a completely closed inner cartilaginous capsule and an outer incomplete osseous case, to which, again, some other cartilaginous elements are appended." From this description and from the fact that a cartilage considered to be a remnant of the hyomandibular has been found in Ceratodus it seems probable that the chondrocranium of this form resembles that of the Fishes more than does that of Protopterus. But the evidence from the chondrocranium of Protopterus, in so far as it may be considered to have value in determining the position of the Dipnoi as a whole, appears to me to be entirely in agreement with the conclusion of W. N. Parker that, "it is certainly inadvisable to retain the Dipnoi among the Fishes, as is still done by some zoologists, and it would be still more undesirable to place them with the Amphibia." It is to be remembered, however, that Protopterus is one of the more specialized forms of the group.

POSTSCRIPT.

Since the foregoing article passed into the hands of the printer a paper by Miss Platt[1] has appeared which deals with the development of the cartilaginous skull of Necturus, giving special attention to the origin of the procartilage cells. In the main our results in regard to the fully chondrified parts entirely agree. Miss Platt finds, however, that in Necturus the number of cartilages arising independently is considerably larger than that described above for Amblystoma. Of these the synotic tectum ('tectum interoccipitale'), the trabecular crest, and the ethmoid ('internasal') plate are of particular interest from the fact that I have not found them to appear as independent cartilages in any of the forms studied. This may, in some cases, be due to the fact that the independent condition is limited to the pro-cartilage stages or to the incompleteness of my series of embryos. But I feel confident that the parts mentioned do not appear as independent cartilages in Amblystoma. The existence of such a condition as that shown in Fig. 18, where there is no sign of cartilage near the median line, and the appearance of a complete tectum in an embryo but little older form the basis of my conclusions in regard to the synotic tectum. My evidence as to the formation of the trabecular crests and the ethmoid plate is of the same nature and shows them to be outgrowths from the primitive trabeculæ.

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[1] Platt, J. B. The development of the cartilaginous skull and of the branchial and hypoglossal musculature in Necturus. Morph. Jahrbuch. xxv, p. 377. 1897.

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EXPLANATION OF THE FIGURES.

REFERENCE LETTERS.

a.	Angular process.
a n p.	Antorbital process.
a p.	Ascending process.
a s.	Arteria perforans stapedia.
b	Foramen for blood vessel.
b o.	Basi-occipital cartilage.
b q.	Body of quadrate.
c.	Cornu trabeculæ.
d.	Dorsal nasal process.
d p.	Descending process of quadrate.
d r.	Dorsal trabecular rod.

* Not seen.

e.	Ethmoid plate.
e c.	Ethmoid canal.
e f.	Endolymphatic foramen.
f.	Fontanelle.
f o.	Fenestra ovalis.
h.	Hyomandibular cartilage.
h y.	Foramen for hyomandibular branch of seventh nerve.
i x.	Foramen for ninth nerve.
j.	Jugular foramen.
j v.	Foramen for branch of jugular vein.
l.	Lamina cribrosa.
l c.	Labial cartilage.
l o c.	Lateral occipital crest.
m.	Meckel's cartilage.
m r.	Marginal rod.
n.	Notochord.
n c.	Nasal capsule.
n i.	Foramen for branch of nasalis internus.
n l.	Nostril.
n s.	Nasal septum.
o.	Otic capsule.
o c.	Oculomotor foramen.
o c p.	Occipital process.
o f.	Optic foramen.
o l.	Olfactory foramen.
o n.	Orbito-nasal foramen.
o p.	Otic process.
p.	Parachordal.
p a l.	Palatine foramen.
p b.	Palato-basal process.
p c.	Palatine cartilage.
p f.	Perilymphatic foramen.
p o b.	Postorbital band.
p p t.	Palato-pterygo-quadrate cartilage.
p r b.	Preorbital band.
p r c.	Preorbital canal.
p t.	Pterygoid process.
q.	Quadrate.

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r.	Rostrum.
r l.	Foramen for ramus lateralis facialis of the seventh nerve.
r m.	Foramen for ramus maxillaris of fifth nerve.
r n.	Foramen for ramus mandibularis of fifth nerve.
r p.	Foramen for ramus ophthalmicus profundus of fifth nerve.
r p i.	Foramen for ramus palatinus inferior.
r p s.	Foramen for ramus palatinus superior.
r s.	Foramen for ramus ophthalmicus superficialis of fifth.
s.	Stapes.
s b.	Supraorbital band.
s p.	Stapedial process.
s t.	Synotic tectum.
s u.	Support of balancer.
t.	Trabecula.
t a.	Tympanic annulus.
t c.	Tegmen cranii.
t e.	Tectal cartilage.
t m.	Taenia tecti medialis.
tr c.	Trabecular crest.
v.	Foramen for branch of fifth nerve.
vii.	Foramen for branch of seventh nerve.
viii.	Foramen for branch of eighth nerve.
v p.	Ventral nasal process.
v r.	Ventral trabecular rod.

EXPLANATION OF PLATE.

Fig. 1. Side view of model from *Amblystoma punctata*, ten mm. long.
Fig. 2. Dorsal view of same.
Fig. 3. Dorsal view of model from *Amblystoma punctata*, eleven mm. long.
Fig. 4. Side view of model from *Amblystoma punctata*, twelve mm. long.
Fig. 5. Dorsal view of same.
Fig. 6. Ventral view of same.
Fig. 7. Dorso-median view of otic capsule of same.
Fig. 8. Side view of model from *Amblystoma jeffersoniana*, thirty-nine mm. long.
Fig. 9. Dorsal view of same.

Fig. 10.	Ventral view of same.
Fig. 11.	Median view of otic capsule of same.
Fig. 12.	Dorsal view of model from *Amblystoma punctata*, sixty-nine mm. long.
Fig. 13.	Ventral view of same.
Fig. 14.	Dorsal view of model from *Desmognathus fusca*, twenty mm. long.
Fig. 15.	Dorsal view of model of nasal capsules from *Plethodon glutinosum*, twenty mm. long.
Fig. 16.	Dorsal view of model from *Necturus maculatus*, forty-five mm. long.
Fig. 17.	Side view of model from young *Amphiuma means*.
Fig. 18.	Dorsal view of same.
Fig. 19.	Ventral view of model from older *Amphiuma*.
Fig. 20.	Dorsal view of model from *Pipa americana*.
Fig. 21.	Ventral view of nasal region of same.
Fig. 22.	Dorsal view of model from young *Ichthyophis glutinosus*.
Fig. 23.	Ventral view of same.
Fig. 24.	Side view of model from older *Ichthyophis glutinosus*.
Fig. 25.	Median view of otic region of same.
Fig. 26.	Dorsal view of nasal capsules of same.
Fig. 27.	Side view of model from young *Polypterus bichir*.
Fig. 28.	Side view of model from trout twenty-two mm. long.
Fig. 29.	Ventral view of same.
Fig. 30.	Side view of model from young *Protopterus annectens*. (See text, p. 130, for error in shape of Meckel's cartilage.)
Fig. 31.	Dorsal view of same.
Fig. 32.	Ventral view of same.

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